ICOGE

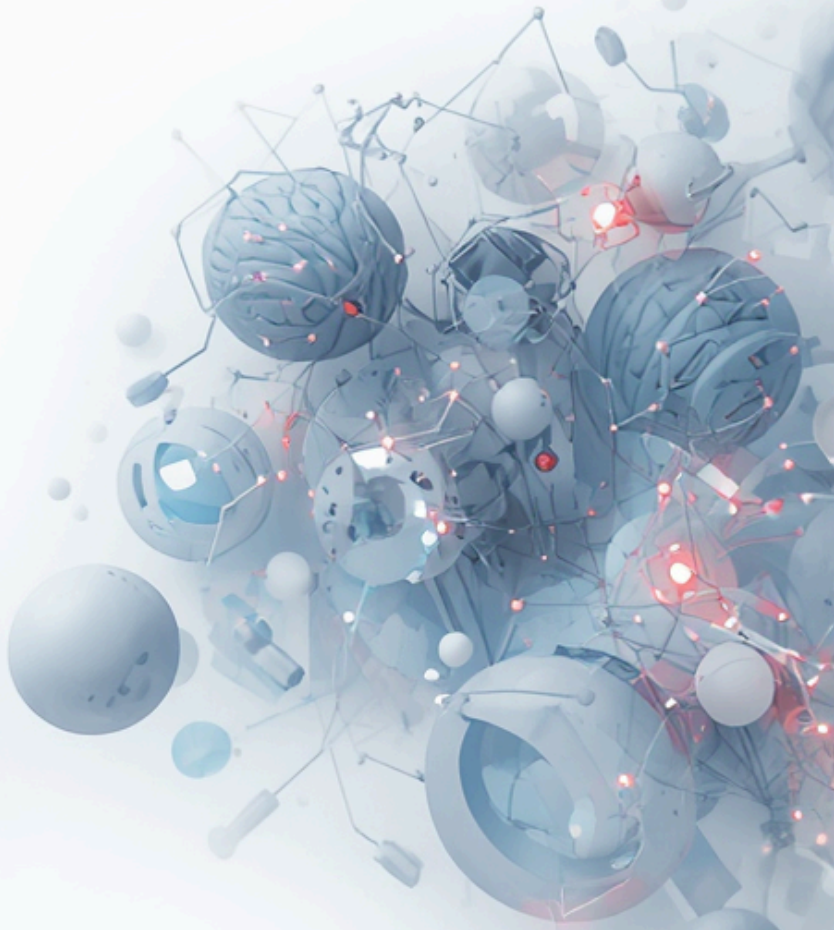
Lincoln University College

4th International Conference on Global Education

"Transforming Education in the Age of AI"

8th- 9th July, 2026

Proceeding Book



School of Education
Lincoln University College,
Malaysia

LINCOLN UNIVERSITY COLLEGE
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SYNOPSIS

The papers in this volume constitute the official proceedings of the *4th International Conference on Global Education (ICOGE 2026)*, themed *Transforming Education in the Age of Artificial Intelligence*, held on 8–9 July 2026 in Malaysia. Organized by the School of Education, Lincoln University College, the conference served as an international platform for educators, researchers, scholars, policymakers, and industry professionals to examine the transformative role of artificial intelligence and emerging technologies in shaping the future of education. Submissions were presented through oral and poster sessions and underwent a rigorous peer-review process by the Programme Committee. Selected papers reflect high academic quality and cover diverse areas of education, including artificial intelligence, educational technology, digital learning, curriculum innovation, teacher education, assessment, leadership, and lifelong learning.

Conference Vision
To establish a globally recognized platform that brings together educators, researchers, practitioners, and policymakers to exchange knowledge, foster innovation, and advance educational excellence in response to emerging technological and societal changes.

Conference Mission
ICOGE 2026 promotes international scholarly collaboration by providing opportunities for researchers and practitioners to share innovative ideas, research findings, and best practices. The conference aims to support the integration of artificial intelligence, digital transformation, and innovative pedagogies in education while fostering leadership, inclusivity, sustainability, and lifelong learning.

Core Principles

- Promotion of innovation and excellence in education and research
- Integration of artificial intelligence and emerging technologies in teaching and learning
- International collaboration and academic networking
- Commitment to integrity, ethics, and professionalism

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PREFACE

We are pleased to present the *Proceedings of the 4th International Conference on Global Education (ICOGE 2026): Transforming Education in the Age of Artificial Intelligence,* held on 8th –9th July 2026 in Malaysia. Organized by the School of Education, Lincoln University College, the conference brought together scholars, educators, researchers, policymakers, and practitioners from around the world to explore emerging trends and transformative practices in education.

The theme, *Transforming Education in the Age of Artificial Intelligence*, reflects the growing need to integrate technological advancements, sustainability principles, and learner-centered approaches into educational systems. ICOGE 2026 served as a vibrant platform for interdisciplinary collaboration, scholarly discussion, and the dissemination of research that contributes to educational innovation and excellence.

We extend our sincere appreciation to the keynote speakers, presenters, reviewers, session chairs, sponsors, and participants whose contributions ensured the success of the conference. Special thanks are also due to the Organizing Committee and Programme Committee for their dedication and commitment to maintaining the highest academic standards. All papers included in these proceedings underwent a rigorous peer-review process to ensure quality, relevance, and scholarly integrity.

We hope that the research presented in this volume will inspire further inquiry, foster international collaboration, and contribute meaningfully to the advancement of education in an increasingly interconnected and digital world. May these proceedings serve as a valuable resource for educators, researchers, and policymakers committed to shaping the future of education.

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W E L C O M E M E S S A G E

Pro-Chancellor, Lincoln University College

It is with great pleasure that I extend a warm welcome to all distinguished participants, scholars, educators, researchers, and practitioners attending the 4th International Conference on Global Education (ICOGE 2026): Transforming Education in the Age of Artificial Intelligence. As the Pro-Chancellor, I am honoured to address this esteemed gathering dedicated to advancing educational innovation and excellence in an increasingly digital world.

Education remains a powerful catalyst for progress, empowering individuals and communities to navigate the opportunities and challenges of a rapidly evolving global landscape. As artificial intelligence continues to reshape the way we teach, learn, and engage with knowledge, it is essential that we explore its potential thoughtfully and responsibly.

This conference provides an invaluable platform for meaningful dialogue, knowledge sharing, and interdisciplinary collaboration. Through scholarly presentations, expert discussions, and innovative research, participants will examine emerging trends, best practices, and transformative approaches that can enhance educational experiences and outcomes worldwide.

Together, we have the opportunity to explore practical solutions, foster global partnerships, and contribute to the development of future-ready educational systems. The insights shared during this conference will undoubtedly inspire new ideas and strengthen our collective commitment to educational excellence.

I extend my sincere appreciation to the ICOGE 2026 Organizing Committee for their dedication and hard work in making this conference possible. I also thank our keynote speakers, presenters, reviewers, and participants for their valuable contributions. Your engagement and expertise are instrumental in creating a vibrant and impactful academic community.

I wish all participants a successful and enriching conference experience.

Thank you,

PROFESSOR. DATUK DR. HJH. BIBI FLORINA BINTI ABDULLAH
Pro-Chancellor
Lincoln University College

W E L C O M E M E S S A G E

Chairman/Founding President, Lincoln University College

I would like to express my sincere appreciation to the faculty and staff of the School of Education for their unwavering commitment and dedication in organizing the 4th International Conference on Global Education (ICOGE 2026). It is my privilege to warmly welcome our distinguished guests, keynote speakers, presenters, participants, and members of the organizing and scientific committees.

It is with great pleasure that I invite you to ICOGE 2026, themed Transforming Education in the Age of Artificial Intelligence. This conference serves as a premier international platform for educators, researchers, scholars, and practitioners to engage in meaningful discussions on the opportunities and challenges presented by artificial intelligence and emerging technologies in education.

Lincoln University College remains steadfast in its commitment to advancing quality, inclusive, and future-oriented education. Through conferences such as ICOGE, we promote academic excellence, collaborative research, and global partnerships that contribute to educational innovation and societal progress. As a leading institution of higher learning, Lincoln University College continues to support impactful research and the development of solutions that address the evolving needs of learners and educators worldwide.

This conference provides an opportunity to exchange ideas, share research findings, and explore innovative approaches that can transform teaching and learning in the digital era. The collective expertise and insights contributed by participants will play a significant role in shaping the future of education and fostering sustainable educational development.

On behalf of Lincoln University College, I extend my heartfelt gratitude to all participants for your valuable contributions and active engagement. I wish you a productive and rewarding conference experience, and I look forward to the knowledge, collaborations, and innovations that will emerge from ICOGE 2026.

Thank you,

PROFESSOR DR. AMIYA BHAUMIK
Chairman/Founding President
Lincoln University College

W E L C O M E M E S S A G E

Vice Chancellor and Chief Executive Officer, Lincoln University College

It is with great pleasure and enthusiasm that I warmly welcome all distinguished participants, scholars, educators, researchers, and practitioners attending the 4th International Conference on Global Education (ICOGE 2026), themed Transforming Education in the Age of Artificial Intelligence. As the Chief Executive Officer, I am honoured to address this esteemed gathering of professionals dedicated to shaping the future of education in an increasingly digital and interconnected world.

Education remains a powerful force for societal progress and global development. As artificial intelligence continues to transform the educational landscape, we are presented with unprecedented opportunities to enhance teaching, learning, research, and innovation. By harnessing knowledge, creativity, and collaboration, we can effectively address emerging challenges while preparing learners for the future.

I extend my deepest appreciation to all authors, researchers, and presenters who have contributed their scholarly work to this conference. Your commitment to advancing educational knowledge and sharing innovative ideas is instrumental in driving meaningful progress within the global education community. I also wish to express my sincere gratitude to the Organizing Committee and Scientific Committee for their dedication, professionalism, and tireless efforts in ensuring the success of ICOGE 2026.

My heartfelt thanks also go to our keynote speakers, invited guests, participants, and partners for their invaluable contributions and continued support. Your engagement enriches the conference experience and fosters the exchange of ideas that inspire educational transformation and excellence.

As we gather to explore the impact of artificial intelligence on education, let us embrace this opportunity to collaborate, innovate, and contribute towards creating more inclusive, equitable, and future-ready learning environments. Together, we can advance educational practices that empower learners and strengthen societies worldwide.

Thank you for being part of ICOGE 2026. I wish you a productive, insightful, and rewarding conference experience.

Much appreciated!

DATUK DR. MOHD YUSOFF A. BAKAR
Vice Chancellor and Chief Executive
Officer Lincoln University College

W E L C O M E M E S S A G E

Dean, School of Education

Greetings and a warm welcome to the **4th International Conference on Global Education (ICOGE 2026)**!

It is my great pleasure to welcome you to this international gathering of scholars, educators, researchers, practitioners, and students. This year's theme, **"Transforming Education in the Age of Artificial Intelligence,"** reflects our shared commitment to reimagining teaching, learning, and educational leadership in response to rapid technological advancement.

Artificial intelligence is transforming the educational landscape, influencing how knowledge is created, accessed, and shared. As these changes continue to reshape education, ICOGE 2026 provides a valuable platform to explore innovative practices, promote inclusive learning, and examine how AI can enhance teaching, research, and educational leadership while addressing emerging opportunities and challenges.

Building upon the success of previous conferences, ICOGE continues to foster meaningful dialogue, interdisciplinary collaboration, and international partnerships. This year's conference encourages participants to explore pressing issues and promising solutions in education from equitable access and learner empowerment to digital innovation and cross-border collaboration.

We are pleased to announce that a substantial number of high-quality abstracts have been accepted for presentation, representing diverse themes and perspectives from around the world. The quality and diversity of these contributions reflect the strong scholarly engagement within our global education community.

My sincere appreciation goes to every author, researcher, and presenter for contributing to ICOGE 2026. Your dedication to advancing educational knowledge is both admirable and inspiring. I also extend my heartfelt gratitude to the organizing committee, scientific committee, reviewers, and supporting staff, whose professionalism and commitment have been instrumental in making this conference possible.

To our distinguished keynote speakers, delegates, and institutional partners, thank you for joining us and sharing your expertise. Your presence enriches this conference and strengthens the global network of collaboration that ICOGE continues to build.

It is with great honour and sincere pleasure that I welcome you all to ICOGE 2026. I trust that the presentations, discussions, and professional connections established during this conference will inspire new ideas, foster meaningful partnerships, and reaffirm our shared commitment to transforming education for learners around the world.

I wish you a productive, rewarding, and memorable conference.

Warm regards,

Professor Dr. Lubna Ali Mohammed
Dean, School of Education
Lincoln University College, Malaysia

W E L C O M E M E S S A G E
Conference Chair

Distinguished guests, honoured keynote and plenary speakers, respected scholars, esteemed delegates, and participants from around the world.

It is both a privilege and a great pleasure to welcome you to the **4th International Conference on Global Education**, themed *"Transforming Education in the Age of Artificial Intelligence."* Your presence here today reflects a shared commitment to advancing knowledge, innovation, and collaboration in education at a truly global level.

We are living in a time of profound transformation. Artificial Intelligence is no longer a distant concept it is actively reshaping how we teach, learn, assess, and engage with knowledge. From personalized learning environments to intelligent tutoring systems and data-driven decision-making, AI is redefining the educational landscape in ways we could scarcely imagine a decade ago.

However, with these opportunities come equally important responsibilities. As educators, researchers, and policymakers, we must critically examine not only how AI can enhance education, but also how it can be implemented ethically, inclusively, and responsibly. Questions of equity, accessibility, data privacy, and the preservation of human values in education must remain at the forefront of our discussions.

This conference provides a vital platform to explore these issues. It brings together diverse voices and perspectives to examine how education systems can adapt to technological advancements while remaining grounded in the principles of fairness, inclusivity, and human development. It is through such dialogue that we can ensure AI becomes a tool for empowerment rather than division.

We are truly honoured to host an exceptional group of keynote speakers, plenary speakers and presenters whose work is at the cutting edge of educational innovation. Your insights will not only deepen our understanding but also inspire new pathways for research, policy, and practice.

I would also like to extend my sincere appreciation to the organizing committee, reviewers, partners, and volunteers whose dedication has made this conference possible. Your efforts have laid the foundation for what promises to be an engaging and impactful event.

As we begin this conference, I encourage each of you to participate actively, exchange ideas openly, and build meaningful collaborations. Let us use this opportunity to reimagine education not just as a system of knowledge transmission, but as a transformative force that prepares learners to thrive in an AI-driven world.

In closing, I wish you all a productive, enriching, and inspiring conference experience. May this conference provide valuable insights, foster meaningful collaborations, and spark innovative ideas that advance education in the age of artificial intelligence.

Thank you.

Associate Prof Dr Chandra Mohan V. Panicker
Conference Chair
School of Education.

K E Y N O T E S P E A K E R

Professor Dr. Midhun Chakkaravarthy

Dean, School of AI Computing and Multimedia Lincoln University College, Malaysia

Dr. Midhun Chakkaravarthy is an accomplished academic, researcher, and corporate trainer who currently holds the position of Dean, Faculty of AI Computing and Multimedia, at Lincoln University College, Malaysia. He is widely recognized for his expertise in artificial intelligence, big data, and cybersecurity. With more than 1,000 citations and an h-index of 16, his research has made a significant impact at the international level. Dr. Midhun has also led several funded research initiatives, including GPU-based security platforms for big data and internet worm propagation models. In addition, he holds patents related to wireless sensor networks and 5G optimization.

As a strategic academic leader, Dr. Midhun has developed interdisciplinary programs aligned with global educational standards, advancing AI and multimedia education. He has strengthened academic partnerships across China, India, Vietnam, Myanmar, and Kyrgyzstan, promoting international collaboration. As a certified HRDF Malaysia trainer, he has delivered corporate training in VBA programming, business intelligence, and data analysis for organizations such as Tekmark Sdn Bhd, Shangri-La Resorts, and Fairmont Industries, bridging academic learning with industry needs.

ABSTRACT

Title: **Reimagining Global Education in the Age of Artificial Intelligence: From Access to Adaptive Learning**

Artificial intelligence is rapidly transforming how the world teaches and learns, shifting the global education agenda from a long-standing focus on access toward a new frontier of adaptive, personalized learning. This keynote examines how AI-driven technologies — intelligent tutoring systems, learning analytics, generative AI, and immersive multimedia — are reshaping classrooms, curricula, and learner experiences across diverse national contexts. Drawing on cross-border perspectives in higher education, the talk explores how institutions can move beyond simply expanding reach to delivering education that responds dynamically to individual needs, abilities, and aspirations. It also confronts the critical challenges that accompany this transformation: the digital divide, data ethics, academic integrity, and the evolving role of educators. The session argues that the future of equitable, high-quality education lies not in replacing human teaching, but in forging a thoughtful human-AI partnership — one that makes learning more inclusive, intelligent, and globally connected. Attendees will leave with a forward-looking framework for harnessing AI to build resilient, future-ready education ecosystems.

K E Y N O T E S P E A K E R

Professor Dr. Johan Eddy Luaran

Faculty of Education University Teknologi Mara, Malaysia

Dr. Johan Eddy Luaran is a Professor of Education at the Faculty of Education, Universiti Teknologi MARA (UiTM), Malaysia, with over 20 years of teaching and learning experience in diverse contexts. He has dedicated his career to researching and supporting meaningful learning for students. After obtaining his Bachelor's degree in Chemical Engineering, he pursued his passion for education and earned a Master's Degree and a PhD in Educational Technology.

His research focuses on the use of technology to promote effective learning, and he has authored several Scopus-indexed papers in this area. Johan has been a leader in several national projects and is recognized for his teaching and learning innovations related to e-learning. In 2014, he was awarded the UiTM e-Learning Award by the Vice-Chancellor, and in 2015 and 2019, he received the Excellence Service Award. Recently he has been appointed as a Visiting Professor for Zhengzhou Preschool Education College (ZZPEC), China. He is currently the Deputy Dean for Research and Industrial Linkages for Faculty of Education, Universiti Teknologi MARA.

ABSTRACT

Title: **Creativity, Cognition, and AI: Rethinking Education for the Digital Age**

Education today is shaped by creativity, cognition, and technology. The digital age has changed how knowledge is accessed and applied, while Artificial Intelligence (AI) is now part of classrooms and learning environments worldwide. Creativity is essential for learners to adapt and innovate. Cognition reminds us that teaching must align with how the brain learns best. AI offers new opportunities to personalize learning and improve assessment, but it must be used responsibly to ensure inclusivity and human-centered education. ICOGE 2026 provides a valuable platform to explore how these elements can work together to create equitable and innovative learning environments. By collaborating across disciplines and borders, we can design education that inspires curiosity, builds resilience, and prepares learners for the challenges of tomorrow.

P L E N A R Y S P E A K E R

Associate Prof. Dr. Fariza Puteh Behak

Faculty of Major Language Studies Islamic Science University of Malaysia

Assoc. Prof. Dr. Fariza Puteh-Behak is an Associate Professor at the Faculty of Major Language Studies, Universiti Sains Islam Malaysia (USIM), specialising in multiliteracies, action research, and English language teaching. She holds a PhD from the University of Southern Queensland, Australia.

With over two decades of academic experience, Dr. Fariza is recognised for her work on adapting and implementing multiliteracies pedagogy across diverse educational settings, from university classrooms to indigenous and marginalised communities. She is the main inventor of the Online Multiliteracies Project Approach (e-MULPA) and Digital Multiliteracies for English Language Learning (DMELL), digital learning innovations that translate multiliteracies theory into classroom practice. Her scholarship spans multiliteracies, employability skills, indigenous education, and participatory action research, earning her a Google Scholar h-index of 13 with over 524 citations. An active contributor to the broader academic community, she serves as Treasurer of the Malaysian Action Research Network (MARNET).

ABSTRACT

Title: **Teacher Roles in the Era of Digital Multiliteracies: Use of Multi-technologies in AI-Enhanced Global Classrooms**

The rapid integration of artificial intelligence and digital technologies into education has fundamentally reshaped what it means to teach and learn in the 21st century. This plenary presentation examines the evolving role of educators in AI-enhanced global classrooms, arguing that teachers must transition from traditional knowledge dispensers to architects of dynamic, multimodal learning ecosystems. Drawing on the New London Group's multiliteracies framework, this presentation traces the shift from monomodal to multimodal communication and explores how generative AI tools have accelerated this transformation. As students increasingly engage with visual, audio, digital, spatial, and gestural modes of meaning-making, educators trained for a pre-digital world face urgent challenges in reimagining their professional identities and pedagogical practices. The plenary presentation introduces a new framework of teacher roles suited to AI-enhanced classrooms — from curators of information and designers of learning environments to global facilitators and digital citizenship educators in a cyber social world. It will also highlight the critical challenges, including the digital divide, over-reliance on AI, student data privacy, and the risk of eroding human connection in over-technologized classrooms. The session concludes with a call to action: to be educators who teach students not merely how to use these tools, but how to think critically with them — navigating an increasingly complex global landscape with agency, empathy, and ethical awareness.

P L E N A R Y S P E A K E R

Associate Prof. Dr. S. J. Kala

Faculty of English Fatima College Madurai, India

Dr. S. J. Kala is an Associate Professor of English and Dean of International Collaboration and Foreign Students' Welfare Cell at Fatima College, Madurai. With nearly three decades of academic experience, she has contributed significantly as an educator, researcher, administrator, and academic leader. A multidisciplinary scholar, she holds advanced degrees in English, Sociology, Hindi, Journalism, and related fields.

She has served in several leadership roles, guided more than sixteen research scholars, and published 53 research papers, 15 conference presentations, and six books. Her research spans language teaching, literature, diaspora studies, journalism, sociology, and tribal heritage preservation. Honored with several awards, Dr. Kala continues to inspire academic excellence and international collaboration.

ABSTRACT

Title: **Higher Education at the Crossroads of Transformation- Abridged**

Artificial Intelligence (AI) is transforming higher education by reshaping how knowledge is created, delivered, and accessed. Moving beyond traditional one-size-fits-all models, AI enables personalised learning experiences by adapting to individual student needs, strengths, and learning styles. It enhances accessibility through real-time translation, assistive technologies, and continuous availability, making education more inclusive and engaging. AI also accelerates research processes and reduces faculty workload in assessment, allowing educators to focus more on mentorship and innovation. However, the integration of AI presents significant challenges, including concerns about academic integrity, reliability of AI-generated content, data privacy, and potential job displacement. As a result, education systems must evolve by adopting new assessment methods and fostering both technical skills—such as AI literacy and data analysis—and essential human competencies like critical thinking, creativity, and ethical reasoning. Ultimately, the responsible and ethical use of AI is key to preparing learners for a rapidly changing future.

P R E - C O N F E R E N C E R E S O U R C E

Associate Prof. Dr. Mustafa Al-Shagga

Director of Education and Student Experience, School of Pharmacy, Faculty of Science, University of Nottingham Malaysia

Dr. Mustafa Al-Shagga is an award-winning Associate Professor and Director of Education and Student Experience at the School of Pharmacy, Faculty of Science, University of Nottingham Malaysia.

With over 25 years of experience in higher education, he is recognized for innovative teaching methods that integrate interactive technologies and role-play. Since joining the University of Nottingham Malaysia in 2013, he has contributed significantly to pharmacy and medical education. He previously served at NUMed, the University of Cyberjaya, Aden University, and hospitals under Yemen's Ministry of Health. Dr. Al-Shagga has received several teaching awards, published over 60 papers, and holds advanced qualifications in medicine, pharmacology, and higher education.

ABSTRACT

Workshop: **From Prompting to Developing an AI-Colleague**

This hands-on workshop helps participants to transfer basic prompting to building autonomous AI workflows. Attendees will work on Claude AI skills for automating complex administrative tasks, explore Opal for game development integration, and maximise NotebookLM to foster teaching and research synthesis. By bridging the gap between theory and practical application, this session empowers educators and postgradue to transform generative AI from a simple tool into an integrated, highly capable digital colleague.

Transformational Leadership and AI Integration in Higher Education Institutions: Evidence from Guangdong Province

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Abstract

The rapid integration of Artificial Intelligence (AI) in higher education institutions (HEIs) has transformed teaching, learning, and administrative processes, requiring leadership approaches that support innovation and organizational change. Transformational leadership, characterized by vision, inspiration, intellectual stimulation, and individualized consideration, has been identified as a critical driver of successful technological adoption. This study investigates the role of transformational leadership in facilitating AI integration in higher education institutions in Guangdong Province, China. Employing a mixed-methods case study approach, quantitative data were collected through structured questionnaires administered to academic and administrative staff, while qualitative insights were obtained from semi-structured interviews with institutional leaders. The findings indicate that transformational leadership significantly influences the effectiveness of AI integration by fostering a supportive organizational culture, enhancing staff readiness, and encouraging collaborative innovation. However, challenges such as disparities in AI competencies, resistance to change, and ethical concerns related to data governance continue to affect implementation outcomes. This study contributes to the literature on leadership and digital transformation in higher education by providing empirical evidence from a regional context. The findings offer practical implications for higher education leaders and policymakers seeking to promote effective AI integration through transformational leadership practices.

Keywords: AI integration, Artificial Intelligence, Guangdong Province, Higher Education Institutions, Transformational Leadership

Introduction

The 21st century has witnessed unprecedented advancements in Artificial Intelligence (AI), which has reshaped industries and societal systems globally, with higher education being no exception (Bass & Riggio, 2006; Northouse, 2021). AI technologies have transcended experimental applications to become integral to core functions of HEIs, including teaching and learning innovation, learning analytics, administrative streamlining, and research management (Zhang & Li, 2023). In China, national strategies such as the New Generation Artificial Intelligence Development Plan have positioned HEIs as key actors in digital educational transformation, and Guangdong Province—an economic and technological pioneer in southern China—has made substantial investments in AI infrastructure and educational digitalization, emerging as a leading

region for AI integration in higher education (Guangdong Provincial Department of Education, 2024).

Leadership is widely recognized as a cornerstone of successful organizational change and technological adoption in higher education (Leithwood e*t al*., 2020; Hallinger, 2022). As AI integration requires fundamental shifts in institutional practices, cultures, and competencies, traditional transactional leadership models—centered on reward and punishment mechanisms—have proven insufficient (Burns, 1978; Bass, 1985). In contrast, transformational leadership, which emphasizes vision-building, inspiration, and collective growth, has been identified as a critical framework for guiding HEIs through AI adoption challenges (Avolio & Bass, 2004; Jones *et al*., 2023). Despite growing attention to AI in higher education, the interplay between transformational leadership and effective AI integration remains underexplored, particularly in Chinese HEIs where institutional structures and cultural contexts differ significantly from Western counterparts.

Theoretically, this study extends transformational leadership theory—originally developed in Western contexts—to China's AI-driven higher education landscape, providing empirical evidence to validate the theory in a non-Western setting. It also bridges the gap between educational leadership and AI integration research, shifting focus from technology to human and organizational factors.

Practically, the findings offer actionable guidance for HEI leaders, policymakers, and educational developers in China and emerging economies. Recommendations can inform leadership development programs and institutional/regional policies for sustainable AI integration. For Guangdong, the study provides insights to leverage existing investments and policy support, solidifying its position as a national hub for educational digitalization.

While numerous HEIs in China and globally have invested heavily in AI technologies, many struggle to translate these investments into sustainable and effective integration (Selwyn, 2021; Williamson, 2022). A primary barrier is the lack of leadership readiness and a clear strategic vision for digital transformation (Baxter & Ankrah, 2020; Li & Wang, 2024). Many HEI leaders lack necessary AI and digital competencies, and institutional AI strategies are often ad hoc rather than embedded in long-term planning. Additionally, resistance to change among staff, compounded by uneven AI literacy, undermines AI adoption (Fullan, 2020; Parry & Winston, 2021). Ethical concerns, including data privacy, algorithmic bias, and inadequate AI governance, further complicate integration efforts (Floridi *et al*., 2018; OECD, 2021).

Notably, there is a paucity of empirical research examining transformational leadership's role in AI integration within Chinese higher education (Han & Zhang, 2023; Zhao *et al*., 2024). Most existing studies focus on Western settings, and research on AI in Chinese HEIs often centers on technological implementation rather than human and organizational factors like leadership. Guangdong Province, with its strong policy support, technological innovation, and institutional diversity, provides a valuable context to address this gap and generate context-specific evidence.

Review of Related Literature

Transformational Leadership Theory

Transformational leadership was first conceptualized by Burns (1978) in Leadership, distinguishing between transactional and transformational styles. Transactional leadership relies on an exchange relationship, with leaders providing rewards or sanctions based on follower performance (Bass, 1985). In contrast, transformational leadership inspires followers to transcend self-interests, embrace shared vision, and strive for collective improvement (Burns, 1978; Avolio & Bass, 2004). Bass (1985) refined the theory by identifying four core dimensions—the Four I's—which form the foundation of empirical research:

Idealized Influence: Leaders act as role models with high ethical standards, credibility, and commitment, fostering trust and admiration among followers (Northouse, 2021).

Inspirational Motivation: Leaders articulate a clear, compelling vision and use motivational language to foster optimism and commitment (Bass & Riggio, 2006).

Intellectual Stimulation: Leaders encourage creativity and critical thinking by challenging assumptions and supporting new problem-solving approaches (Leithwood *et al*., 2020).

Individualized Consideration: Leaders recognize individual needs and provide personalized support, coaching, and mentorship (Hallinger, 2022).

Subsequent research has validated the Four I's framework across educational contexts, linking transformational leadership to improved teacher motivation, organizational culture, and student outcomes (Day et al., 2016; Leithwood et al., 2020). In digital transformation, it has emerged as a key driver of technological adoption, addressing both technical and human dimensions of change (Bersin, 2019; Jones et al., 2023).

AI Integration in Higher Education

AI integration in HEIs refers to embedding AI technologies into core processes: teaching and learning, administration, research management, and student support (Siemens & Baker, 2012; Dede, 2018). AI tools include adaptive learning systems, learning analytics dashboards, intelligent tutoring systems, automated workflows, and AI-driven research tools (OECD, 2021; Selwyn, 2021). Core goals include enhancing teaching quality, improving administrative efficiency, enabling data-driven decision-making, and supporting innovative research (Williamson, 2022; Floridi et al., 2018).

Research identifies technological factors (infrastructure, access, technical support) as essential for basic adoption (Bates, 2021; Han, 2023), but human and organizational factors—staff AI literacy, culture, leadership, strategy—are primary determinants of sustainable integration (Selwyn, 2021; Zhang & Liu, 2024). Without supportive culture, effective leadership, and clear strategy, even advanced AI fails to deliver meaningful outcomes (Williamson, 2022; Baxter & Ankrah, 2020).

In Chinese higher education, AI integration is driven by strong national and regional policy support (Ministry of Education of China, 2023; Guangdong Provincial Government, 2024). The Ministry of Education has prioritized AI for educational digitalization, funding research and upgrading infrastructure. Guangdong has aligned regional policy with national strategy, investing heavily in AI in HEIs. Despite this, many HEIs face challenges: uneven AI literacy, resistance to change, and lack of context-specific strategies (Wang et al., 2023; Yang, 2024).

The Intersection of Transformational Leadership and AI Integration

The intersection of transformational leadership and AI integration is a nascent research area, with most studies focusing on Western contexts (Jones et al., 2023; Parry & Winston, 2021). These studies confirm transformational leadership as a critical enabler of AI integration, addressing human and organizational barriers (Baxter & Ankrah, 2020; Bersin, 2019). Transformational leaders articulate AI visions aligned with institutional goals, inspire staff to embrace AI, and build AI literacy capacity (Leithwood et al., 2020; Hallinger, 2022). They also foster innovation cultures and address ethical concerns through governance frameworks (Floridi et al., 2018; OECD, 2021).

Transformational leadership influences AI integration through direct and indirect mechanisms (Jones et al., 2023). Directly, leaders develop AI strategies, allocate resources, and set adoption expectations. Indirectly, they shape culture and staff attitudes toward technology (Baxter & Ankrah, 2020). A culture of trust and collaboration mediates the relationship between transformational leadership and AI integration success (Fullan, 2020; Parry & Winston, 2021).

Notably, empirical research on this intersection in Chinese HEIs is scarce (Li & Zhang, 2024; Wang et al., 2023). Existing Chinese studies focus on general digital transformation rather than AI, lacking context-specific evidence on transformational leadership practices. This study addresses this gap by analyzing transformational leadership and AI integration in Guangdong HEIs.

This study aims to systematically investigate the role of transformational leadership in facilitating AI integration in Guangdong HEIs. The specific objectives are:

1. To examine key transformational leadership practices in Guangdong HEIs actively implementing AI technologies.
2. To analyze how transformational leadership influences AI adoption across core institutional functions (teaching, administration, governance).
3. To identify primary challenges faced by HEI leaders in AI integration.
4. To provide evidence-based recommendations for developing effective AI-driven transformational leadership practices in Chinese HEIs.

Research Questions

To address the objectives, the following research questions guide the study:

1. What specific transformational leadership practices support AI integration in Guangdong HEIs?
2. How does transformational leadership shape AI integration effectiveness in Guangdong HEIs' core functions?
3. What key challenges do Guangdong HEI leaders face in leading AI integration, and how do these impact outcomes?

Methodology

Conceptual Framework

Based on the literature, a conceptual framework is developed (Figure 1), positing relationships between transformational leadership (independent variable, operationalized via Bass's Four I's), AI integration (mediating variable, across teaching, administration, governance), institutional effectiveness (dependent variable, measuring AI's impact on

pedagogical quality, administrative performance, etc.), and contextual moderators (organizational culture and staff readiness).

Organizational culture—characterized by collaboration and innovation—moderates the relationship, as transformational leadership thrives in cultures supporting shared vision (Fullan, 2020; Hallinger, 2022). Staff readiness—AI literacy, competencies, and attitudes—also moderates, as transformational leadership can only drive AI integration if staff have the capacity and willingness to adopt AI (Jones et al., 2023; Parry & Winston, 2021). This framework guides the study's design and analysis.

Note: Figure 1 is a structural model depicting transformational leadership influencing institutional effectiveness via AI integration, with organizational culture and staff readiness as moderators.

Research Design

This study adopts a mixed-methods case study design (Creswell & Clark, 2017; Yin, 2018), combining quantitative and qualitative methods to explore transformational leadership and AI integration in Guangdong HEIs. The case study design is suitable for investigating complex phenomena in real-world contexts (Yin, 2018). An explanatory sequential design is used: quantitative data is collected first to identify patterns, followed by qualitative data to explain these patterns (Creswell, 2014). Findings are integrated for comprehensive interpretation.

Research Setting

The research is conducted in Guangdong Province, a national leader in technological innovation and educational digitalization. Guangdong's diverse HEIs—top research universities, comprehensive universities, vocational colleges, and private institutions—represent China's higher education landscape (Guangdong Provincial Department of Education, 2024). The province's substantial AI investments and policy support make it ideal for this study.

A purposive sample of 6 HEIs is selected based on: (1) formal AI integration strategy; (2) AI implementation across at least two core functions; (3) representation of different HEI types. Selected HEIs are located in Guangzhou, Shenzhen, and Zhuhai—key technological hubs.

Participants

Two participant groups from the 6 HEIs (all with direct AI integration experience) are included:

1. Quantitative participants: 350 academic and administrative staff selected via stratified random sampling (Cohen et al., 2018), stratified by job role and institutional type. After excluding incomplete questionnaires, 322 valid responses (92% response rate) are used.
2. Qualitative participants: 20 senior leaders (presidents, vice presidents, deans, IT directors) selected via purposive sampling (Patton, 2015), ensuring insight into AI leadership decision-making.

Data Collection Methods

Quantitative Data: Structured Questionnaires

Structured questionnaires measure transformational leadership, AI integration, and institutional effectiveness. The questionnaire, adapted from validated scales and translated into Chinese (with back-translation for accuracy; Brislin, 1970), includes four sections:

1. Demographic information (age, gender, job role, AI experience).
2. Transformational leadership: Measured via the Multifactor Leadership Questionnaire (MLQ; Bass & Avolio, 1995), 20 items on a 5-point Likert scale.
3. AI integration: 15-item scale (based on Siemens & Baker, 2012; OECD, 2021), 5-point Likert scale.
4. Institutional effectiveness: 12-item scale (based on Bates, 2021; Selwyn, 2021), 5-point Likert scale.

Questionnaires are distributed online over four weeks in Spring 2025, with reminder emails sent to non-respondents.

Qualitative Data: Semi-Structured Interviews

Semi-structured interviews explore leadership practices, AI integration experiences, and challenges (Patton, 2015; Kvale & Brinkmann, 2015). An interview protocol (pilot-tested with two senior leaders) includes open-ended questions on leadership practices, AI influence, and challenges.

Interviews (45–60 minutes each) are conducted face-to-face or via video conference (March–May 2025), audio-recorded with consent, and transcribed verbatim. Field notes capture non-verbal cues.

Analysis

Quantitative Data Analysis

SPSS 28.0 (IBM, 2021) is used for analysis:

1. Descriptive statistics (mean, SD, frequency) describe sample characteristics and key variables.
2. Reliability (Cronbach's $\alpha \geq 0.7$) and validity (EFA, factor loadings ≥ 0.5) are tested (Nunnally, 1978; Hair et al., 2019).
3. Inferential statistics: Pearson correlation (bivariate relationships) and multiple regression (mediating role of AI integration; Baron & Kenny, 1986), $p < 0.05$.

Qualitative Data Analysis

Thematic analysis (Braun & Clarke, 2006) is used, supported by NVivo 12 (QSR International, 2020). Stages include: familiarization, initial coding, theme development, theme review, theme definition, and reporting. Interview excerpts are translated into English, preserving context.

Integration of Findings

Quantitative and qualitative findings are integrated at the interpretation stage (Creswell & Clark, 2017), with quantitative patterns explained by qualitative insights for a nuanced understanding.

Ethical Considerations

All procedures follow APA (2020) and BERA (2018) guidelines: informed consent, anonymity/confidentiality, voluntary participation, and secure data storage. Ethical approval is obtained from Lincoln University College's Research Ethics Committee.

Findings and Discussion

Transformational Leadership Practices in AI-Integrating HEIs

Quantitative findings show moderate to high transformational leadership levels ($M = 3.92$, $SD = 0.61$) on the 5-point MLQ scale, with all Four I's above 3.0. Idealized influence ($M = 4.05$, $SD = 0.57$) and inspirational motivation ($M = 3.98$, $SD = 0.60$) score highest; intellectual stimulation ($M = 3.80$, $SD = 0.66$) and individualized consideration ($M = 3.85$, $SD = 0.64$) score slightly lower. The MLQ scale is reliable (Cronbach's $\alpha = 0.90$).

Qualitative findings identify four key practices aligned with the Four I's:

1. Clear digital vision (Inspirational Motivation): Leaders develop AI visions aligned with national/regional strategies, communicating via staff meetings, newsletters, and workshops to enhance engagement.
2. Ethical role modeling (Idealized Influence): Leaders participate in AI training, use AI tools, and establish ethical guidelines to model commitment and responsible AI use.
3. Innovation support (Intellectual Stimulation): AI innovation funds and sharing sessions create a safe space for trial-and-error, encouraging staff to experiment with AI.
4. Personalized support (Individualized Consideration): Tailored AI training (basic for admins, advanced for academics) and one-on-one coaching address uneven literacy and resistance.

The Influence of Transformational Leadership on AI Integration Effectiveness

Quantitative Findings

Significant positive correlations are found: transformational leadership and AI integration ($r = 0.69$, $p < 0.001$), transformational leadership and institutional effectiveness ($r = 0.73$, $p < 0.001$), AI integration and institutional effectiveness ($r = 0.77$, $p < 0.001$). Multiple regression confirms AI integration mediates the relationship between transformational leadership and institutional effectiveness ($\beta = 0.51$, $p < 0.001$), accounting for 67% of the total effect ($\beta = 0.78$, $p < 0.001$).

Qualitative Findings

Transformational leadership enhances AI integration effectiveness in three key ways:

1. Teaching and learning innovation: Leaders inspire adoption of AI tools (adaptive learning, analytics), fostering personalized learning and collaborative pedagogical innovation.
2. Administrative efficiency: AI automation (enrolment, finance, HR) streamlines tasks, freeing staff for value-added work, with cross-departmental collaboration enhanced.
3. Data-driven governance: AI analytics enable evidence-based decision-making, fostering a data-informed culture aligned with institutional goals.

Transformational leadership also increases institutional innovation capacity, fostering continuous learning and adaptation.

Challenges Faced by Leaders in AI Integration

Four key challenges are identified:

1. Uneven AI literacy: Disparities exist (M = 3.25, SD = 0.88), with STEM staff having higher literacy than humanities and administrative staff.
2. Resistance to change: 33% of respondents resist AI, due to fear of job displacement, time constraints, and preference for traditional practices (senior staff most resistant).
3. Ethical concerns: Only 46% of respondents report clear AI ethical guidelines, with concerns about data privacy and algorithmic bias.
4. Limited infrastructure/training: 39% report insufficient infrastructure, 43% inadequate ongoing training, due to limited funding and human resources.

Transformational Leadership as a Core Driver of AI-Enabled Change

Findings confirm transformational leadership as a critical driver of AI integration in Guangdong HEIs, aligning with Western research (Jones et al., 2023; Baxter & Ankrah, 2020). All Four I's contribute to effectiveness, with idealized influence and inspirational motivation most prominent. This validates Bass's (1985) theory in China's AI-driven higher education, extending its reach beyond Western contexts (Hallinger & Wang, 2019; Li & Zhang, 2024).

Transformational leadership influences AI integration through technical (strategy, resource allocation) and human (culture, staff readiness) dimensions, addressing both "hardware" and "software" of digital change (Selwyn, 2021; Williamson, 2022). The mediating role of AI integration confirms that transformational leadership enables meaningful AI adoption that delivers tangible institutional outcomes.

Contextual Specificities of Transformational Leadership in Chinese HEIs

Three contextual specificities are identified:

1. Policy alignment: Leadership is closely aligned with national/regional digital strategies, providing a clear framework for AI integration (Ministry of Education of China, 2023; Guangdong Provincial Government, 2024), differing from fragmented Western policy support (Williamson, 2022).
2. Collectivist focus: Leaders frame AI integration as a collective endeavor, fostering cross-departmental collaboration, reflecting China's collectivist culture (Hofstede, 2011), unlike Western emphasis on individual autonomy (Northouse, 2021).
3. Top-down but inclusive decision-making: Leaders set the AI vision (top-down) but involve staff in implementation (inclusive), balancing hierarchical structures with collaborative transformational practices (Yang, 2024; Han, 2023).

Addressing AI Integration Challenges Through Transformational Leadership

Transformational leadership mitigates challenges by: providing personalized training for uneven literacy; communicating AI benefits and involving staff to reduce resistance; establishing ethical frameworks for data privacy; advocating for funding to address infrastructure/training gaps (Jones et al., 2023; Fullan, 2020). It also builds institutional resilience, enabling adaptation to technological change (Leithwood et al., 2020; Hallinger, 2022).

Alignment with Digital and Transformational Leadership Theories
Findings align with digital leadership theory (Bersin, 2019; Baxter & Ankrah, 2020), confirming that effective AI leadership combines transformational practices with digital competencies. They also align with educational change leadership (Fullan, 2020; Kotter, 2012), as leaders use vision, collaboration, and capacity building to drive AI integration as an organizational reform.

Theoretical Implications
1. Extends transformational leadership theory to China's AI-driven higher education, validating the Four I's framework in a non-Western context.
2. Confirms AI integration's mediating role, clarifying the mechanism linking transformational leadership to institutional effectiveness.
3. Identifies cultural adaptations of transformational leadership in Chinese HEIs, contributing to cross-cultural leadership literature.
4. Bridges the gap between educational leadership and AI integration research, emphasizing human/organizational factors.

Practical Implications
1. Develop AI-focused transformational leadership programs, combining leadership training with AI literacy.
2. Formulate strategic, participatory AI integration plans aligned with institutional and policy goals.
3. Implement targeted AI training for all staff, addressing uneven literacy.
4. Establish robust AI ethics and governance frameworks.
5. Increase investment in AI infrastructure and ongoing training support.

Recommendations
Based on findings, recommendations include:
1. Mandate AI-focused transformational leadership training for senior HEI leaders, including peer mentorship.
2. Establish AI integration committees with leader, staff, and student representation.
3. Create a regional network for HEIs to share AI best practices and resources.
4. Integrate AI literacy into mandatory staff professional development, with incentives for AI innovation.
5. Develop a provincial AI ethics framework for Guangdong HEIs.
6. Allocate dedicated, long-term funding for AI infrastructure and training.

Conclusion
This study confirms transformational leadership as a critical driver of AI integration in Guangdong HEIs, with all Four I's contributing to effectiveness. It influences AI integration through technical and human dimensions, fostering supportive cultures and staff readiness. Key challenges—uneven literacy, resistance, ethical concerns, infrastructure gaps—are mitigated by transformational leadership, which builds institutional resilience.

Contextual specificities of transformational leadership in Chinese HEIs—policy alignment, collectivist focus, inclusive top-down decision-making—highlight the need for cultural adaptation of leadership theories. The study extends transformational leadership theory, validates AI integration's mediating role, and bridges leadership and AI research gaps.

Practical recommendations provide actionable guidance for stakeholders to advance sustainable AI integration. As AI reshapes higher education, investing in transformational leadership and AI capacity building will be critical for HEIs to remain agile and effective. For Guangdong, this will solidify its position as a global hub for educational digitalization and AI innovation.

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Artificial Intelligence and Data-Driven Resource Allocation in Higher Education: Implications for Institutional Performance

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Abstract

Artificial intelligence (AI) and data analytics are increasingly transforming governance and decision-making processes in higher education institutions. Universities are progressively adopting AI-supported analytical systems to guide strategic planning, optimize resource allocation, and improve institutional performance. While existing research has extensively examined the pedagogical applications of AI, comparatively limited attention has been devoted to its role in institutional management and resource governance. This study explores how artificial intelligence and data-driven analytics can enhance the efficiency and transparency of resource allocation within higher education institutions and how these improvements contribute to institutional performance. Drawing on theories of data-driven governance and organizational decision-making, the study proposes a conceptual framework that links AI-enabled analytics to improved managerial decision quality, more efficient resource allocation, and enhanced institutional performance. Using a conceptual-analytical approach informed by recent empirical literature and institutional practices, the paper examines how AI-based analytical systems facilitate evidence-based management in universities. The analysis suggests that AI-driven decision systems can significantly reduce information asymmetry in institutional governance, improve transparency in resource distribution, and strengthen strategic decision-making capacity. This study contributes to the emerging literature on artificial intelligence in higher education governance by integrating technological innovation with institutional resource management. The findings provide practical insights for policymakers and university leaders seeking to leverage AI-enabled decision systems to enhance institutional efficiency, accountability, and long-term sustainability in an increasingly data-driven educational environment.

Keywords: Artificial Intelligence, Data-Driven Governance, Higher Education Management, Institutional Performance, Resource Allocation

Introduction

Higher education institutions today operate within an increasingly competitive and underfunded landscape, while facing divergent stakeholder expectations and mounting accountability requirements. Universities are no longer merely instructional entities; rather, they function as sophisticated knowledge organizations whose overall performance hinges on instructional quality, research output, graduate outcomes, societal engagement, financial viability, and administrative agility. Resource allocation has evolved beyond routine administrative practice into a substantive governance challenge.

Budget distribution, staffing arrangements, infrastructure development, digital platform construction, research funding support, student service provision, and academic program development collectively exert direct influence on institutional performance.

Artificial intelligence and data analytics constitute instrumental tools for the governance and operational management of higher education. Artificial intelligence encompasses a broad spectrum of applications including adaptive learning systems, automated academic assessment, intelligent tutoring mechanisms, and generative learning support, among others, and has been widely deployed within higher education institutions. AI-driven analytics enable institutional administrators to identify underlying patterns pertaining to student enrolment trends, retention rates, learning outcomes, faculty workload distribution, research performance, campus space utilization, and financial operational performance. By integrating such multidimensional data streams into institutional decision-support systems, universities can transition from conventional reactive management toward strategic proactive governance. Artificial intelligence serves as a complement rather than a substitute for professional academic judgment; it enhances institutional managerial intelligence by rendering institutional data more accessible, temporally timely, and empirically comparable.

This consideration is particularly critical given the inherent structural constraints within university operations. Academic departments compete for limited financial resources, research centres require sustained capital investment, students demand enhanced personalized support services, and digital infrastructure necessitates continuous upgrading and modernization. Conventional resource allocation practices typically rely on historical budget baselines, stakeholder bargaining leverage, incremental funding adjustments, and fragmented institutional reporting frameworks. While stable, they may perpetuate inefficiencies, obscure performance gaps, weaken alignment. AI-supported analytics can provide an approach to improve quality, speed and transparency of information available to decision-makers.

Although these opportunities exist, integrating AI in higher education governance requires careful planning. Supposedly AI automatically improve decision making is technologically deterministic and inadequate.AI systems only add value if integrated into appropriate governance frameworks, ethical guidelines, institutional data culture and human oversight. Poor data quality, algorithm bias, limited interpretability, privacy risks and uneven capacity can make decisions based on AI highly reliable and legitimate. Thus, the question is not whether universities should adopt AI, but how to use AI responsibly to optimize resources and improve performance in institutions.

Review of Related Literature

There are numerous studies on AI in education, such as learning analytics, intelligent tutoring and student-facing technologies (Chen et al., 2020; Zawacki-Richter et al., 2019). However, less attention has been given to AI as a tool of institutional governance in resource allocation and organisational performance because universities are increasingly pushed to justify investments, demonstrate value, improve efficiency and align resources to strategic priorities. This paper explores how artificial intelligence and data-driven analytics can increase resource allocation efficiency and institutional performance in higher education. It presents a conceptual argument that AI-based analytics improve decision quality and thus improve resource allocation efficiency and institutional performance. We conceptualize the literature and propose the framework for future

empirical testing and institutional use. we split the paper into sections: introduction, literature review, conceptual framework, methodology, discussion, policy implications, conclusion and references.

Artificial Intelligence in Higher Education Management

Artificial intelligence is a computational system that performs tasks that typically require human intelligence such as pattern recognition, prediction, classification, natural language processing, and decision support. In higher education, AI is often discussed in teaching and learning. Intelligent tutoring systems, automated feedback, adaptive platforms, and generative AI applications have garnered considerable research and policy interest (Chen et al., 2020; Ouyang & Jiao, 2021), but same analytical powers that improve learning can also be applied to institution management. Universities produce enormous amounts of data from admissions, enrollments, learning management systems, finance, human resources, research management, facilities, alumni relations, and student services, and AI can transform this data into predictive and diagnostic intelligence, making it more actionable. The role of AI is threefold: first it provides descriptive intelligence by studying fragmented data in order to identify trends in resource use and performance; second it predicts future enrollment, student demand, staff workload, budget or research output; third, it provides prescriptive intelligence by suggesting scenarios and other allocation strategies for different goals; These functions are important for resource management since allocation decisions are often uncertain, competing priorities and delayed consequences.

AI should not be considered as a technical solution, but a sociotechnical governance in which algorithms, data, routines, professional expertise and ethical concerns interact. For example, an AI model might suggest that a particular program needs more student support resources, but the decision on how to allocate funds is based on strategic priorities, equity considerations, decisions on academic issues and feasibility. AI can also identify underutilized space in classrooms, but space allocation decisions must be agreed by faculties and departments. AI-supported management is best when AI complements human decision making, rather than replacing human decision making.

The literature on AI education presents both opportunities and risks. UNESCO stresses human centered AI governance, ethical safeguards, inclusion and capacity building (Miao et al. 2021; UNESCO 2023). OECD states that smart technologies can transform education systems but they need to be implemented, fair design and evidence-based governance (OECD 2021). These policies will have important implications for resource allocation because AI systems can influence which programs are funded, which students fit best to be involved, and which institutions are very valuable. AI based allocation should also be transparent, explicable and accountable. Another question is whether artificial intelligence adoption will institutionalize its use. Adoption is buying or using AI tools, institutionalization is deepening AI into decision making, policy, professional roles, accountability. Many universities have data dashboards or analytics tools but do not use them fully to govern. AI value in higher education management is not limited to technological availability. It depends on whether the evidence is understood, debated and used.

Data-Driven Decision-Making

Data driven decision making is a decision-making process using data, tools, metrics and indicators to make decisions in an organization. In higher education, data driven decision

making is used to prove quality, efficiency and accountability of universities to governments, accreditation bodies, students, employers and society. Learning analytics studies show that educational data can support interventions if it matches meaningful learning goals (Gaevi et al. 2015; Siemens & Long 2011, 2011). At the institution level, data can be useful when it pertains to decision making problems and understood in a governance context.

The main advantage of data driven decisions is the symmetry: Senior leaders often lack timely information about program demand, staff load, student performance, research performance, administrative problems, Departments may have local knowledge but not comparable data. Data analysis can fill these gaps by creating shared information environments. By establishing consistent indicators and interpretable indicators, decision makers can allocate resources transparently without informal bargaining, past entitlements or incomplete assumptions. Data-driven governance presents both methodological problems as well as ethical ones: Data may be incomplete, inconsistent or biased, performance indicators may oversimplify complicated tasks, algorithms may focus on measurable results rather than visible results such as community involvement, mentoring or collaboration, and analytics may promote compliance rather than real improvement. These concerns demonstrate that data-driven decision making should not be confused with automated quantification, but rather with evidence-based decision making where quantitative indicators combine qualitative judgment and align to mission. For resource allocation, data driven decisions are critical since wrong allocation can have cumulative effects. Underinvestment in student support could affect retention and graduation rates, lack of funding for research could affect long-term competitiveness, overinvestment in low-demand programs could harm financial stability.AI-based analytics help universities identify risk early and allocate resources proactively. Data driven systems should also include review mechanisms, stakeholder participation and clear documentation of decision criteria.

A data governance model depends on the following conditions: (1) quality of data: accuracy, interoperability, time and relevance; (2) Staff and tools need analysis; (3) Decision integration: decision output should link planning, budgeting, evaluation, reporting cycles; (4) Privacy, transparency algorithm, bias control and responsible use. Without these conditions universities produce more data without better decisions.

Resource Allocation and Institutional Performance

University priorities need to be translated into results. Financial budget, staff appointment, grant funding, student services, digital infrastructure, facilities and administrative capacity are important factors which determine whether a university can achieve its mission. In higher education, resource allocation is difficult because universities want to achieve several goals at once. Teaching quality, research excellence, access, equity, employability, internationalization, social contribution, financial sustainability, etc. are all valid but may not always align in the short term.

In this paper, institutional performance is considered as a combination of several aspects. Educational performance refers to retention of students, progression, learning outcomes, graduate employment and student satisfaction. Research performance refers to publications, citations, external grants, research collaboration and innovation outputs. Operating performance refers to budget efficiency, process quality, service responsiveness and infrastructure use. Strategic performance refers to reputation, sustainability, adaptability and alignment to the mission of the institution. This is

important because evaluating a university only on a single financial indicator is not sufficient.

Objectives

Decision quality mediates the relationship between resource allocation and performance. Allocating more resources won't deliver better results if they don't fit institutional needs. On the other hand, even small resources can improve performance if allocation decisions are evidence-based, strategically coherent and adaptive to changing conditions. AI-based analytics can help align resources where they need the most, where investments likely will have high value for institutional use and where resources are underutilized.

Organizational decisions are more effective if decisions are informed by data, coordinated across departments and feedback loops. For universities, resource allocation should be tied to the monitoring process. For example, the decision to improve academic advising should be based on changes in student retention, course completion, and student satisfaction. Investment in research should also be evaluated on grant success, research collaboration, publication quality, and postgraduate training capacity. AI and analytics can provide feedback loops linking resource allocation to performance.

Performance based resource allocation should not be reduced. If algorithms focus on easily measured results, institutions may overlook equity, freedom, early research, or disciplines that offer long term social value but short-term financial gain. AI supported allocation should therefore focus on balanced performance frameworks integrating quantitative metrics, qualitative evidence, strategic priorities, and fairness considerations.

Methodology

Conceptual Framework

This paper proposes a framework linking artificial intelligence and data analytics to institutional performance focusing on decision quality and resource allocation efficiency. The framework relies on the assumption that AI enables information sharing in institutional governance. By making large fragments of data into useful evidence, AI can improve decision quality. Decision quality improves resource allocation and improves institutional performance.

The independent construct focuses on AI and data analytics, how much higher education institutions use AI-based systems to manage data, collect, integrate, analyze, predict and interpret data for different functions such as planning, budgeting, student support, human resource management, research administration, and operational management. The construct emphasizes the real use of data analysis in decision making instead of just having the technology. The mediator is decision quality: how well managerial decisions are evidence-based, timely, transparent, strategically aligned and ethically justified? AI-based systems can enhance decision quality: reduce uncertainty, increase visibility of institutional trends, enable scenario analysis, and support more consistent decision making. Decision quality relies on human interpretation, leadership capacity, governance rules. AI is therefore seen as an enabler rather than as an autonomous decision maker.

The idea here is resource allocation efficiency, i.e., allocation resources efficiently to maximize educational, research, operational and strategic value while minimizing waste, duplication and misalignment. In higher education efficiency is more than cost reduction,

but strategical alignment, directing resources to areas that support mission, student success, academic quality, research development and long-term sustainability.

The dependent construct is institutions performance (education quality, research productivity, operations efficiency, accountability, stakeholder satisfaction, sustainability etc.). We believe that reducing resource efficiency can impact these results by making sure necessary needs are recognized and addressed. For example, predictive models may detect programs high demand, students dropping out, departments with unbalanced workload, or processes with unneeded delays. Making resource decisions based on such evidence can result in improved performance over time.

The framework is designed in a sequence: AI and data analytics improve decision quality; better decision quality improves resource allocation efficiency; efficient resource allocation improves institutional performance. Ethical governance, data quality, organizational readiness and leadership capacity are also factors that influence AI-enabled analytics success. Without reliable data, skilled interpretation and responsible governance, the technology might lead to poor or damaging decisions.

This framework presents four propositions: 1) AI-enabled analytics positively affect decision making quality in higher education management; 2) better decision-making quality increases resource allocation efficiency; 3) efficient resource allocation improves performance; and 4) Decision quality and resource allocation efficiency is determining whether AI-enabled analytics positively affect the performance of institutions. These propositions provide the basis for future empirical work using survey data, institutional performance indicators, case studies or mixed-method designs.

Table 1. Conceptual Constructs and Expected Functional Contributions

Construct	Role in the framework	Expected contribution
AI and data analytics	Independent construct	Integrates institutional data, supports prediction, and enables evidence-informed governance.
Decision-making quality	Mediating construct	Improves transparency, timeliness, strategic alignment, and defensibility of managerial choices.
Resource allocation efficiency	Mechanism construct	Aligns financial, human, digital, and academic resources with institutional priorities and needs.
Institutional performance	Dependent construct	Reflects educational quality, research productivity, operational effectiveness, accountability, and sustainability.

Note. Author construct based on the literature synthesis.

This paper has conceptual-analytical approach that allows clarifying constructs, synthesising fragments of literature, proposing relationships and guiding future work. The goal of this paper is not statistical hypothesis testing but a theoretically coherent model explaining how AI and data analytics could influence resource allocation and institutional performance in higher education. This approach is appropriate as AI is still emerging in university governance and needs conceptualization.

The analysis follows three directions: in the first direction, artificial intelligence applications, learning analytics, digital transformation, human-cantered AI governance (Chen et al., 2020; Ouyang & Jiao, 2021; Zawacki-Richter et al., 2019); in the second direction, data driven decision making, educational analytics, and leveraging evidence for improving institutional processes and learning environments (Gaevi et al., 2015; Siemens & Long, 2011); in the third direction, organizational decision making, digital transformation, and public accountability with broad concepts for understanding institutional impact of analytics-based governance (Davenport & Ronanki, 2018; Williamson, 2017).

The process consisted of four steps. First, we identified the main issue: Lack of conceptual discussions on AI-based resource allocation in higher education management. Second, we reviewed literature to identify key constructs and mechanisms. Third, constructs were grouped into conceptual framework connecting AI and data analytics with decision quality, resource allocation efficiency, and institutional performance. Fourth, implications were drawn for university leaders, policy makers and future researchers. The approach is analytical rather than meta-analytic but follows a rigorous logical framework for conceptual synthesis.

This paper is very limited. Since direct empirical estimates of causal effects are not currently available, the relationship between the effects is largely theoretical. Future work should therefore aim to validate the model across different kinds of institutions, national settings, governance and degree of digital maturity. As mentioned above, AI systems vary in design, data requirements and applications considerably, thus generalizations cannot be applied to any organization at all. Despite these limitations, this framework provides a solid foundation for AI research and related policy initiatives.

Findings and Discussion

Improved Decision Transparency

The most obvious way AI can improve institutions is to increase transparency. In many universities, resource allocation is hard to track because it is distributed between committees, departments, budget cycles and leadership levels. In many cases past allocations continue without explanation and stakeholders do not know why some units get more resources than others. This can cause distrust, unfair impressions and a lack of commitment to priorities.

AI can improve transparency showing evidence, criteria and trade-offs. Dashboards and decision support systems can show enrolment trends, workload, cost, research activity, student progress and demand similar way. Decision makers and stakeholders can see information and allocation debates can change from personal claims to evidence discussions. Transparency cannot eliminate disagreements but can improve quality by clarifying decisions basis.

Transparency assumes paramount importance prevailing fiscal constraints. In contexts involving university budget reductions or competing investor prioritization of resource allocation, institutional leaders are compelled to provide rigorous justification for contentious administrative decisions. AI can explain why resources are allocated to high-risk groups, research areas, digital infrastructure, high demand programs and also identify areas of poor use of resources. Transparency is explainable: If the stakeholders cannot understand how an algorithm generates recommendations, AI may trigger suspicion

instead of legitimacy. Universities should implement explainable analytics and document assumptions on models.

Transparency improves accountability. When resources are allocated according to goals, institutions can check whether they achieve their goals. Transparency enhances institutional accountability. When resource allocation aligns with strategic goals, institutions can evaluate goal attainment. Schools may track educational investments via retention and completion indicators; measure research funding effectiveness through grant performance and publication quality; and assess digital systems based on service efficiency and user satisfaction. Such feedback fosters organizational learning and reduces recurrence of allocation errors. However, data protection and professional judgement should be balanced. Not all data should be publicly disclosed and decisions should not be limited to performance measures. Sensitive information about students, staff, finances or research should be handled responsibly. Academic value often includes qualitative aspects difficult to quantify. AI should help transparent evidence use instead of pure algorithm control.

Enhanced Resource Efficiency

Resource efficiency extends beyond cost reduction to a point where resources are used according to needs, mission and performance. AI-based analytics can help in this direction by finding patterns not seen in traditional reports. For example, predictive analytics can find programs with higher enrolment or lower enrolment, courses with regular failure risk, groups of students needing help, or underutilized facilities. Artificial intelligence is used in university operations such as program development, staffing and student support. By studying enrolment data, AI can detect trends in increased demand for a field, adapt faculty appointments, allocate lab space or change curricula in order to meet demands of students and job market. Artificial intelligence can also use learning data to predict and prevent student problems. Monitoring student performance in courses, institutions can help students early by offering personalized tutoring, advice, or design help, help students to solve problems before they become more severe.

AML can plan scenario. Universities may have uncertainties about enrolment, funding, research income, operating cost when budgeting. AI can model different scenarios and estimate effects of different allocation strategies. Leaders may decide whether digital infrastructure is better than expanding student services or whether funding from low-demand programs should be reinvested in emerging fields. Scenario analysis does not decide which decision to make but helps leaders understand risks and trade-offs.

Analytical data can help managers identify imbalances in workload, staffing needs, professional development priorities and bottlenecks. Faculty workload is challenging due to the variety of teaching, research, supervision, service and engagement activities across different disciplines. An analytics system can help plan a better workload than just a productivity measure. Data can help administration managers identify late admissions, finance, procurement, student services delays and improve resources.

Efficiency gains depend on readiness of the institution.AI systems require reliable integration of data, analytical expertise, committed leadership, trust among staff. Fragmented data can lead to inaccurate analysis. Staff view AI as surveillance tool and resist it. Leaders view efficiency as cost cutting instead of value creation. Leaders view

efficiency only as cost cutting, AI can affect morale and quality. Resource efficiency relies on participatory governance and clear description of AI's purpose and limitations.

Strategic Institutional Planning

Strategic institutional planning is vital for University to cope with uncertainty and uncertainty of current environment. The complexity arises from demographic changes, labour market changes, technological advances, increased competition, increasing public accountability demands. Strategic planning is analysis of trends, risks and allocate resources to future priorities. AI can improve this process by providing timely information, evidence-based decision support and forecasting tools.

Strategic planning is more than a plan. It is the process of determining mission, resources, capabilities and performance of a university. AI can improve this process by integrating data from academic, financial, research and operations. For example, a university may combine enrolment forecasts, labour market data, graduate outcomes data and research strengths to identify the program improvement opportunities. Analytics can also track progress towards goals and adjust resources accordingly. AI is critical for institution resilience. When a disaster strikes, whether a pandemic, economic crisis, or sudden change in demand for students, universities need to make fast, evidence-based decisions. Analytics systems warn institutions of financial risk, withdrawals, staff capacity and digital infrastructure requirements. Institutions with robust data infrastructure can react quicker and allocate resources more flexibly.

Another benefit of cross-unit coordination: Universities operate mostly autonomously as faculties, departments, centres and departments, and can be varied but fragmented. AI-based institutional analytics can provide common evidence between units, and leaders can identify duplicate work, collaboration opportunities and system priorities. Analytics might show that several departments need similar tools or some clusters need shared infrastructure for more integrated resource planning.

Strategic planning must remain mission driven. AI cannot lead universities to focus on easy-optimized indicators. Social responsibility, values, and public mission should guide the use of analytics. Strategic planning of institutions requires normative analysis of performance, considering who is on priority list and balance efficiency with equity and quality. AI can only improve planning when these questions are addressed explicitly.

Policy Implications

This analysis has several implications for university leaders and policy makers. First, universities should invest in integrated data infrastructure. AI-based resources rely on reliable data from student information systems, finance, human resources, research management, facilities and learning platforms. Fragmented data systems hinder institutions from generating accurate and timely insights. Investigation should focus not only on AI tools, but also on data governance, interoperability, cybersecurity and institutional reporting standards.

Second, universities need human-cantered AI governance frameworks that state the purpose of AI use, decision-making authority, accountability, privacy protections, and review algorithm outputs.AI recommendations should be inputs for consideration, not decisions. Human oversight should be used when allocation decisions affect students,

faculty, programs, equity considerations, etc. Governance frameworks should also include formal procedures for finding and eliminating bias.

Third, institutions need to develop analytical skills of administrators and professors. Data driven governance requires staff that understands analytics, understands its limitations and communicates results responsibly. Professional development should include data literacy, ethical AI awareness, strategic planning and evidence-based decisions. Without this skill, AI systems may not be used, misunderstood or applied mechanically. Fourth, policy makers should promote responsible digital transformation of higher education. National and regional policy frameworks can motivate institutions to use AI responsibly, fairly and quality wise, funding can help build shared data infrastructures, capacity and research on AI governance. Policy makers should not enforce narrow performance measures that lead to superficial optimizations, but balanced performance measures such as quality of learning, research contributions, social impact, sustainability and equity.
Fifth, universities should involve stakeholders: AI-supported resource decisions can impact students, staff, professional staff, and partners. Engaging stakeholders can help the decision process to be more credible, uncover contextual information and minimize resistance. Engaging stakeholders doesn't mean every decision must be made together, it means assumptions, indicators, and goals of AI-supported decision systems should be open and open to scrutiny.

Institutions must evaluate impact of AI-based resource allocation. Implementation should include monitoring and research. Universities must determine whether AI-based decisions improve retention, research productivity, service quality, financial stability or trust, and consider unintended effects such as bias, over-standardization, excessive surveillance or lack of autonomy. AI should always be evaluated and evaluated.

Conclusion

Artificial intelligence and data-driven analytics are increasingly being used in higher education governance. While most discussion has been on teaching and learning, we focus on institutional management of AI. We argue that AI-based analytics can improve institutional performance by improving decision quality and resource allocation efficiency. Universities using responsibly used AI can reduce information asymmetry, increase transparency, identify resource needs, support strategic planning and accountability. This idea is related to AI decisions, resource allocation efficiency decisions, institutional performance, AI improves performance not only by technology but also by integrating with governance processes. Decision quality links analytics results with allocation results; resource allocation efficiency plays a role in better decisions. This can be used for future experiments and practice of institutional experiments.

This paper repeats the warning above. AI can perpetuate bias, hide accountability, prioritize quantifiable results or destroy trust if implemented without ethical governance and human oversight. Universities should use AI to support decisions rather than acting as an autonomous allocation authority.AI-based resource governance depends on data quality, institutional readiness, leadership, stakeholder involvement and academic values. Finally, AI and data analytics can be used to improve resource allocation and performance in higher education, but the real value of AI is not technology itself but its integration into transparent, ethical and mission driven governance systems. Policy makers and universities should design AI enabled systems that improve efficiency, fairness,

judgement and accountability. Future work should test this approach in higher education and see how institutional culture, governance and digital maturity influence AI enabled analytics performance results.

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Enhancing Compliance in AI-Enabled Tax Systems for Malaysian SMEs: Role of Trust and Technological Reliability

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Abstract
This paper examines the enhancement of tax compliance among Malaysian small and medium-sized enterprises (SMEs) through AI-enabled tax systems, with particular emphasis on the roles of trust and technological reliability. Grounded in the Theory of Planned Behaviour (TPB), the study examines how trust in AI technologies and perceptions of system dependability influence SMEs' attitudes, subjective norms, perceived behavioural control and voluntary tax compliance intention. A quantitative research design was adopted using structured questionnaires administered to SME owners, directors and senior finance personnel across Malaysia. A total of 248 valid responses were retained for analysis using Partial Least Squares Structural Equation Modelling (PLS-SEM). The results show that trust in AI and technological reliability significantly influence the TPB constructs. Attitude, subjective norms and perceived behavioural control also significantly affect compliance intention, with attitude and perceived behavioural control emerging as stronger predictors than subjective norms. The model explains 58.4% of the variance in tax compliance intention. The findings extend TPB by incorporating AI-related technological perceptions into tax compliance research and provide practical implications for tax authorities, SMEs and digital tax platform developers.

Keywords: AI-enabled tax systems, Malaysian SMEs, Tax Compliance, Trust in AI, Technological Reliability, Theory of Planned Behaviour

Introduction

Small and Medium-sized Enterprises (SMEs) in Malaysia constitute a cornerstone of the national economy by not only generating substantial employment opportunities but also by stimulating entrepreneurial activities and contributing significantly to economic diversification. Their agility and adaptability allow them to respond swiftly to market changes, thereby fostering innovation and competitiveness within various sectors. However, this dynamic role is accompanied by inherent challenges for tax authorities, primarily due to SMEs often limited financial and accounting expertise, which can impede accurate tax reporting and compliance. Additionally, disparities in digital literacy among SME operators further complicate the implementation and monitoring of tax regulations, as digital tools and platforms become increasingly integral to tax administration processes. Furthermore, the varying levels of compliance awareness among SMEs highlight the critical influence of organizational and behavioural factors on

tax compliance outcomes. Research underscores that organizational capability, which includes the availability of skilled personnel and robust internal controls, plays a pivotal role in determining how effectively SMEs meet their tax obligations. Audit exposure acts as a deterrent, encouraging adherence to tax laws by increasing the perceived risk of non-compliance. Behavioural intention, shaped by attitudes toward taxation and perceived fairness of the tax system, also significantly impacts compliance decisions. Together, these factors create a complex compliance landscape that requires tailored strategies from tax authorities to support SMEs, enhance their compliance capacity, and ultimately secure steady revenue flows for the government (Bani-Khalid et al., 2022; Mohamed & Gan, 2024).

Malaysia's tax landscape is swiftly evolving with the adoption of digital technologies such as electronic filing, e-invoicing, data analytics, and technology-driven compliance monitoring. Artificial intelligence (AI) holds the promise of enhancing tax administration by identifying discrepancies, automating routine verifications, minimizing manual tasks, and facilitating more prompt compliance actions. Nonetheless, the effectiveness of AI-powered tax systems is not solely reliant on technological implementation. It also hinges on whether SMEs have confidence in these systems, view them as dependable, and feel capable of adhering to compliance requirements through these platforms (Belahouaoui & Attak, 2024; Lim & Seng, 2024).

Previous research on tax compliance has often utilized psychological and behavioral theories to understand the reasons behind voluntary taxpayer compliance. The Theory of Planned Behaviour (TPB) is particularly significant as it accounts for intention through factors such as attitude, subjective norms, and perceived behavioral control (Ajzen, 1991). However, the advent of AI-driven tax administration brings new technological factors into play. In an AI-driven context, SMEs might assess tax compliance not just as a legal duty, but also considering aspects like system transparency, algorithmic dependability, perceived fairness, data security, and user-friendliness (Lai et al., 2025; Mohd Rasdi, 2025).

There is a significant research gap in comprehending how trust in AI and the reliability of technology interact with the constructs of the Theory of Planned Behavior (TPB) to affect the intention of voluntary tax compliance among Malaysian SMEs. Although previous studies have explored digital taxation and technology adoption, there is a scarcity of empirical research that incorporates AI-specific trust and reliability perceptions into a tax compliance behavioral model (Bani-Khalid et al., 2022; Belahouaoui & Attak, 2024; Prastiwi & Diamastuti, 2023). This paper seeks to fill that gap by empirically testing an expanded TPB framework using PLS-SEM.

This research makes three significant contributions to existing literature. Firstly, it enhances the Theory of Planned Behaviour (TPB) by adding trust in artificial intelligence and the dependability of technology as precursors to behavioural beliefs within a digital tax context. Secondly, it concentrates on Malaysian small and medium-sized enterprises (SMEs), a crucial taxpayer group in the shift towards digital taxation. Lastly, it offers practical guidance for tax authorities and system developers on how trust and technological reliability can bolster the intention for voluntary compliance.

Review of Related Literature

Theory of Planned Behaviour in Tax Compliance

The Theory of Planned Behaviour posits that an individual's intention to perform a behavior is shaped by their attitude, the social norms they perceive, and their perceived control over the behavior (Ajzen, 1991). Attitude refers to how positively or negatively a person or organization regards a specific behavior. In terms of tax compliance, a positive attitude may arise when taxpayers view compliance as fair, beneficial, efficient, or a professional obligation. Research on SMEs utilizing the TPB framework also indicates that taxpayers' intentions are influenced by their evaluation of compliance, the social expectations they perceive, and their perceived ability to comply (Bani-Khalid et al., 2022).

Subjective norms refer to the social or institutional pressures that can either promote or deter certain behaviors. For small and medium-sized enterprises (SMEs), these pressures may come from various sources such as tax authorities, accountants, tax agents, auditors, peers in the industry, clients, suppliers, and financial institutions. Perceived behavioral control relates to how easy or difficult an individual believes it is to perform a particular action. In terms of tax compliance, this includes an SME's perceived ability to understand requirements, maintain records, use digital tools, and handle tax-related challenges.

The Theory of Planned Behavior (TPB) is appropriate for this study because voluntary compliance involves more than just an economic decision driven by fines and inspections. It is also influenced by beliefs, expectations, confidence, and perceived capability. In a tax landscape enhanced by AI, these psychological elements may become more significant as small and medium-sized enterprises (SMEs) are required to interact with systems they may not fully understand (Belahouaoui & Attak, 2024; Lai et al., 2025).

Trust in AI-Enabled Tax Systems

Trust is essential in digital public administration because taxpayers must rely on systems that manage, process, and evaluate sensitive financial information. This study examines trust in AI, focusing on how small and medium-sized enterprises view AI-powered tax systems as secure, fair, transparent, and efficient in ensuring accurate tax management. Trust becomes especially important when automated systems could influence risk assessment, compliance monitoring, or audit selection (Okanga, 2021; Prastiwi & Diamastuti, 2023).

When small and medium-sized enterprises (SMEs) trust AI-powered tax systems, they tend to view digital tax compliance more positively. This confidence can ease worries about random penalties, algorithmic bias, and data misuse. It might also enhance the perception that the tax authority is using technology to improve service quality rather than just ramping up enforcement actions. As a result, trust is expected to influence attitudes, subjective norms, and perceived behavioural control (Prastiwi & Diamastuti, 2023).

Technological Reliability

Technological reliability refers to the perceived accuracy, stability, consistency, and dependability of AI-powered tax systems. For small and medium-sized enterprises (SMEs), the dependability of these systems is a practical concern, as tax compliance often requires meeting deadlines, submitting documents, and conducting data matching and

reconciliation. System errors, downtime, incorrect prompts, or unclear algorithmic outputs can increase the compliance burden and erode trust. Previous studies on SME digitalization and AI adoption suggest that the perceived quality, usefulness, and reliability of a system influence both the adoption of technology and its ongoing use (Lai et al., 2025; Lim & Seng, 2024; Yang & Ming, 2024).

Reliable systems can improve SMEs' sense of control over their actions by making compliance tasks easier to perform. Furthermore, they can enhance positive attitudes towards digital tax compliance and strengthen the perception that digital compliance is a commonly accepted and professionally expected norm. As a result, technological dependability is viewed as an external factor affecting the core elements of the TPB (Mohd Rasdi, 2025; Soomro et al., 2025).

Hypotheses Development
H1a: Trust in AI systems significantly and positively influences SMEs' attitudes toward tax compliance.
H1b: Trust in AI systems significantly and positively influences SMEs' subjective norms toward tax compliance.
H1c: Trust in AI systems significantly and positively influences SMEs' perceived behavioural control toward tax compliance.
H2a: Technological reliability significantly and positively influences SMEs' attitudes toward tax compliance.
H2b: Technological reliability significantly and positively influences SMEs' subjective norms toward tax compliance.
H2c: Technological reliability significantly and positively influences SMEs’ perceived behavioural control toward tax compliance.
H3a: Attitude significantly and positively influences tax compliance intention.
H3b: Subjective norms significantly and positively influence tax compliance intention.
H3c: Perceived behavioural control significantly and positively influences tax compliance intention.

Research Questions

The objectives of this study are to examine the effects of trust in AI and technological reliability on the TPB constructs and to evaluate the influence of attitude, subjective norms and perceived behavioural control on tax compliance intention among Malaysian SMEs.

RQ1: How does trust in AI influence attitude, subjective norms and perceived behavioural control among Malaysian SMEs?
RQ2: How does technological reliability influence attitude, subjective norms and perceived behavioural control among Malaysian SMEs?
RQ3: How do attitude, subjective norms and perceived behavioural control influence tax compliance intention among Malaysian SMEs?

Methodology

Research Design and Sample

This study used a cross-sectional quantitative research design to examine the structural relationships among trust in AI, technological reliability, TPB constructs and voluntary tax compliance intentions. The target population comprised Malaysian SME owners, directors, accountants, finance managers and senior officers involved in accounting, tax

reporting, e-invoicing or compliance-related decisions. Quantitative survey designs are commonly used in TPB-based compliance and SME technology adoption studies because they allow hypothesised relationships among latent constructs to be statistically tested (Bani-Khalid et al., 2022; Soomro et al., 2025).

A purposive sampling approach was adopted because the study required respondents with knowledge of SME compliance practices and digital tax administration. A total of 248 valid and complete SME responses were retained for analysis. The sample size is considered adequate for PLS-SEM because it exceeds the minimum requirement for assessing the structural model and is appropriate for a prediction-oriented model with multiple latent constructs and hypothesised paths.

Measurement of Constructs

The questionnaire measured all constructs using a five-point Likert scale ranging from 1 = Strongly Disagree to 5 = Strongly Agree. Trust in AI was measured using items related to confidence, fairness, security and reliance on automated tax systems. Technological reliability was measured using items related to accuracy, uptime, system stability and dependable automated processing. Attitude, subjective norms, perceived behavioural control and compliance intention were adapted from TPB-based compliance literature (Ajzen, 1991; Bani-Khalid et al., 2022; Prastiwi & Diamastuti, 2023).

Analysis

Data Analysis Method

The data were analysed using Partial Least Squares Structural Equation Modelling (PLS-SEM). The analysis involved two stages. First, the measurement model was evaluated for indicator reliability, internal consistency reliability, convergent validity and discriminant validity. Second, the structural model was assessed using bootstrapping with 5,000 resamples to evaluate path coefficients, t-values, p-values and hypothesis decisions. PLS-SEM is appropriate for prediction-oriented models involving multiple latent constructs and structural paths, particularly in SME technology and behavioural research (Soomro et al., 2025).

Conceptual Framework

The conceptual framework integrates trust in AI and technological reliability as AI-enabled tax system perceptions that influence the TPB constructs. Attitude, subjective norms and perceived behavioural control are then modelled as direct predictors of tax compliance intention.

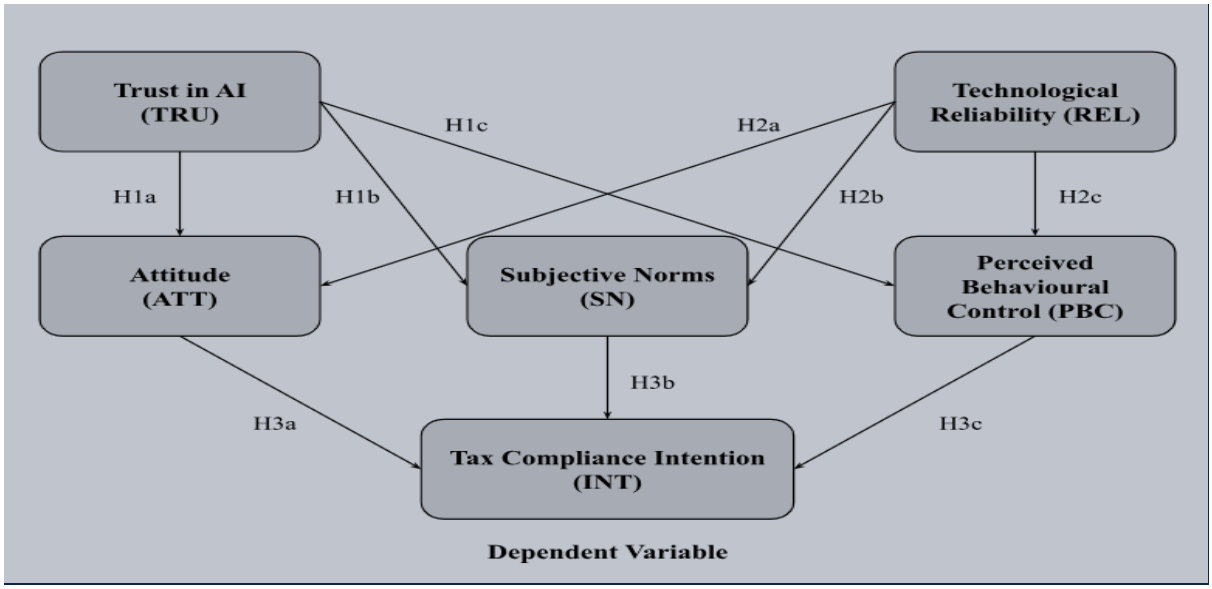

Figure 1. Conceptual Framework Integrating Trust in AI and Technological Reliability with TPB

Findings and Discussion

Measurement Model Assessment

The measurement model was assessed for reliability and validity. The results show that all factor loadings exceeded the recommended threshold of 0.70, indicating adequate indicator reliability. Cronbach's Alpha values ranged from 0.762 to 0.847, while Composite Reliability values ranged from 0.863 to 0.906. These values demonstrate satisfactory internal consistency across all constructs. Convergent validity was also established because all Average Variance Extracted values exceeded 0.50, ranging from 0.641 to 0.762.

Table 1. Measurement Model Assessment

Latent Construct	Indicators	Loading Range	Cronbach's Alpha	Composite Reliability	AVE
Trust in AI (TRU)	TRU1-TRU4	0.798-0.845	0.844	0.895	0.681
Technological Reliability (REL)	REL1-REL4	0.789-0.854	0.847	0.897	0.686
Attitude (ATT)	ATT1-ATT3	0.841-0.880	0.829	0.897	0.744
Subjective Norms (SN)	SN1-SN3	0.802-0.839	0.762	0.863	0.677
Perceived Behavioural Control (PBC)	PBC1-PBC4	0.765-0.834	0.813	0.877	0.641

Latent Construct	Indicators	Loading Range	Cronbach's Alpha	Composite Reliability	AVE
Compliance Intention (INT)	INT1-INT3	0.855-0.891	0.844	0.906	0.762

Discriminant Validity

Discriminant validity was assessed using the Heterotrait-Monotrait ratio. The reported HTMT results were below the recommended threshold, indicating that the latent constructs were empirically distinct. Therefore, the model satisfied the main reliability and validity requirements before proceeding to the structural model assessment.

Structural Model and Hypothesis Testing

The structural model was examined using bootstrapping with 5,000 resamples. The model explained 58.4% of the variance in voluntary tax compliance intention (R^2 = 0.584), indicating moderate to substantial explanatory power. The results show that all hypothesised relationships were positive and statistically significant.

Table 2. Structural Path Coefficients and Hypothesis Summary

Hypothesis	Structural Path	β	t-value	p-value	Decision
H1a	Trust in AI -> Attitude	0.412	6.541	< 0.001	Supported
H1b	Trust in AI -> Subjective Norms	0.284	3.912	< 0.001	Supported
H1c	Trust in AI -> Perceived Behavioural Control	0.335	4.881	< 0.001	Supported
H2a	Technological Reliability -> Attitude	0.356	5.233	< 0.001	Supported
H2b	Technological Reliability -> Subjective Norms	0.310	4.105	< 0.001	Supported
H2c	Technological Reliability -> Perceived Behavioural Control	0.462	7.129	< 0.001	Supported
H3a	Attitude -> Compliance Intention	0.388	5.922	< 0.001	Supported

Hypothesis	Structural Path	β	t-value	p-value	Decision
H3b	Subjective Norms -> Compliance Intention	0.195	2.844	0.005	Supported
H3c	Perceived Behavioural Control -> Compliance Intention	0.341	5.116	< 0.001	Supported

Interpretation of Findings

H1a is supported because trust in AI significantly and positively influences attitude (β = 0.412, p < 0.001). This indicates that SMEs that perceive AI-enabled tax systems as transparent, secure and fair are more likely to develop favourable evaluations of digital tax compliance.

H1b is supported because trust in AI significantly and positively influences subjective norms (β = 0.284, p < 0.001). This suggests that trust in AI strengthens perceived expectations from regulators, tax professionals and business stakeholders regarding compliance through digital tax systems.

H1c is supported because trust in AI significantly and positively influences perceived behavioural control (β = 0.335, p < 0.001). Trust therefore increases SMEs' confidence in their ability to comply using AI-enabled platforms.

H2a is supported because technological reliability significantly and positively influences attitude (β = 0.356, p < 0.001). Reliable systems encourage SMEs to view digital tax compliance more positively.

H2b is supported because technological reliability significantly and positively influences subjective norms (β = 0.310, p < 0.001). This implies that reliable digital infrastructure reinforces the perception that AI-enabled compliance is becoming an expected and accepted practice.

H2c is supported because technological reliability significantly and positively influences perceived behavioural control (β = 0.462, p < 0.001). This is the strongest relationship in the model, showing that system reliability is particularly important in improving SMEs' perceived capability to comply.

H3a is supported because attitude significantly and positively influences compliance intention (β = 0.388, p < 0.001). Favourable evaluations of AI-enabled tax systems increase SMEs' intention to comply voluntarily.

H3b is supported because subjective norms significantly and positively influence compliance intention (β = 0.195, p = 0.005). Although the effect is significant, it is weaker than the effects of attitude and perceived behavioural control, indicating that external pressure matters but is not the strongest driver.

H3c is supported because perceived behavioural control significantly and positively influences compliance intention ($\beta = 0.341$, $p < 0.001$). SMEs are more likely to comply when they believe they possess the knowledge, resources and digital capability required to fulfil tax obligations.

Analysis and Discussion

Empirical findings indicate that trust in artificial intelligence and the reliability of technology are crucial factors influencing how individuals respond to AI-driven tax systems. Trust in AI has the most significant impact on attitudes, implying that small and medium-sized enterprises are more inclined to view digital tax compliance positively when they perceive the system as secure, equitable, and reliable. This finding aligns with previous research suggesting that institutional trust, respectful treatment, and perceived fairness can enhance voluntary compliance behaviour (Okanga, 2021; Prastiwi & Diamastuti, 2023).

Technological dependability significantly influences perceived behavioural control. This insight is crucial for SMEs, as their ability to comply is often hindered by limited resources, insufficient technical knowledge, and worries about system complexity. When AI-driven tax systems are precise, reliable, and easy to use, SMEs feel more in control of their compliance duties. This finding is consistent with studies on SME technology adoption, which indicate that system quality, digital preparedness, and AI capabilities affect both adoption and performance results (Lai et al., 2025; Lim & Seng, 2024; Mohd Rasdi, 2025; Soomro et al., 2025).

Among the TPB constructs, attitude is the strongest predictor of voluntary tax compliance intention, followed by perceived behavioural control and subjective norms. This suggests that SMEs' internal evaluation of AI-enabled compliance and their confidence in using the system are more influential than external social pressure. Nevertheless, subjective norms remain statistically significant, showing that expectations from regulators, advisers and business networks continue to influence compliance intention. These results support the continued relevance of TPB in explaining SME tax compliance intention (Ajzen, 1991; Bani-Khalid et al., 2022).

The findings lend support to the expanded TPB model. Trust in artificial intelligence and the dependability of technology influence behavioural beliefs, societal expectations, and perceived abilities, which in turn affect the intention to comply voluntarily. Consequently, the results indicate that AI-driven tax compliance should not be viewed solely as a technological implementation task. Rather, it necessitates a comprehensive approach that integrates system reliability, taxpayer trust, digital proficiency, and institutional backing.

Conclusion

This study examined the influence of trust in AI and technological reliability on voluntary tax compliance intention among Malaysian SMEs using an extended TPB framework. Based on 248 valid SME responses and PLS-SEM analysis, all hypotheses were supported. The results indicate that trust in AI and technological reliability significantly influence attitude, subjective norms and perceived behavioural control. In turn, the TPB constructs significantly affect voluntary tax compliance intention. The model explains 58.4% of the variance in compliance intention, suggesting that the framework has meaningful explanatory power.

Theoretical Implications

This research enhances tax compliance literature by integrating the Theory of Planned Behaviour (TPB) into the realm of AI-driven tax administration. It highlights that perceptions related to AI, especially trust and reliability, play a crucial role in shaping behavioural intentions. Consequently, the study connects tax compliance research with digital transformation and AI governance by illustrating how technological perceptions impact compliance behaviour through established behavioural frameworks (Ajzen, 1991; Belahouaoui & Attak, 2024).

Practical and Policy Implications

The results indicate that tax authorities should develop AI-driven tax systems that emphasize transparency, fairness, and clarity. Small and medium-sized enterprises are more inclined to comply willingly when they have confidence in how the system handles data and aids in making compliance decisions. For those developing systems, the most compelling empirical evidence suggests that the dependability of technology is vital for perceived control over behaviour. Therefore, it is essential to focus on system uptime, precision, automated checks, user support, and mechanisms for resolving errors. The findings underscore the importance of small and medium-sized enterprises and their professional advisers to develop digital tax skills. Offering training, advisory services, and clear guidance on implementation can boost SMEs' confidence in adopting AI-driven tax systems.

Limitations and Future Research

This research is constrained by its cross-sectional approach and dependence on self-reported survey responses. Future investigations might employ longitudinal methods to explore if the intention to comply leads to compliance behaviour. Additionally, upcoming studies could compare different SME sectors, company sizes, or jurisdictions to assess whether the impacts of trust and technological reliability vary in different settings.

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Transforming Early Childhood Education Management in the Age of Artificial Intelligence: From Crisis Survival to Sustainable Innovation — A Leadership Model Based on Twenty Years of Kindergarten Practice in China

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Abstract

Artificial Intelligence (AI) is reshaping educational systems worldwide, creating both opportunities and challenges for educational leaders. While existing research has largely focused on AI-assisted teaching and learning, limited attention has been paid to how AI can support organizational transformation in early childhood education, particularly within private kindergarten systems facing demographic decline and increasing competition. This study draws upon more than twenty years of kindergarten leadership experience in China, including the establishment and management of multiple kindergarten campuses serving over 20,000 children. Using a practice-based qualitative case study approach, the paper examines how one kindergarten organization navigated two major crises: the COVID-19 pandemic and the subsequent decline in birth rates accompanied by rapid expansion of public kindergarten provision. The study proposes the Human-Centered AI Leadership (HAIL) Model, consisting of five interconnected dimensions: Strategic Digital Leadership, AI-Empowered Teacher Development, Intelligent Family-School Collaboration, Data-Informed Organizational Management, and Holistic Child Development. Findings indicate that AI is most effective when positioned as a tool that enhances human relationships rather than replaces them. The study further demonstrates how AI can reduce operational costs, improve teaching efficiency, strengthen family engagement, support teacher development, and contribute to sustainable organizational transformation. The paper provides practical insights for educational leaders seeking to navigate educational transformation in the age of Artificial Intelligence.

Keywords: Artificial Intelligence; Educational Leadership; Early Childhood Education; Kindergarten Management; Educational Transformation; Human-Cantered Education

Introduction

The rapid emergence of Artificial Intelligence (AI) is transforming educational systems around the world. Educational institutions are increasingly adopting AI technologies to support learning, administration, assessment, communication, and organizational decision-making.

However, most discussions concerning AI in education focus primarily on schools and universities. Comparatively little attention has been paid to early childhood education, particularly the leadership and management challenges faced by kindergarten administrators. This issue has become especially important in China, where private kindergartens are experiencing unprecedented pressures resulting from declining birth rates, expanding public kindergarten provision, rising operational costs, and changing parental expectations.

Objectives

As a kindergarten leader who has worked in the field for more than twenty years, it has been personally witnessed the rise, peak, disruption, and transformation of the private kindergarten sector. These experiences provide a unique opportunity to explore how educational leadership can respond to rapid technological and social change.

The Changing Landscape of Chinese Early Childhood Education

Between 2022 and 2026, significant structural changes occurred within the kindergarten sector of Ganzhou City, Jiangxi Province.

Table 1: Changes in Ganzhou Kindergarten Sector (2022–2026)

Indicator	2022	2026	change
Total kindergartens	1,592	1,316	-17.3%
Public kindergartens	605	799	+32.1%
Private kindergartens	987	517	-47.6%
Total enrollment	286,720	267.627	Declining
private Enrollment	159.235	55.329	-65.3%

During this period, private kindergartens lost more than 100,000 enrolled children, while nearly half of all private kindergartens disappeared through closure, merger, or public acquisition. This trend reflects broader demographic and policy changes occurring throughout China. For private kindergarten operators, survival increasingly depends upon innovation, operational efficiency, educational quality, and organizational adaptability.

Methodology

This study adopts a qualitative practice-based case study approach.

The research draws upon:

- Twenty years of educational leadership experience
- Management of eleven kindergartens
- Service to more than 20,000 children and families
- Organizational records
- Teacher training systems
- Parent engagement data
- Digital management systems

The purpose is not merely to analyze AI adoption, but to understand how educational organizations can transform sustainably under conditions of crisis and uncertainty.

Researcher Positionality and Personal Leadership Narrative

For more than twenty years, it has been worked as both an educational entrepreneur and kindergarten leader.

At the peak of operation, my educational organization managed nine kindergartens serving 2,569 children and employing 269 teachers. However, due to declining birth rates and the rapid expansion of public kindergarten provision, four kindergartens were acquired by local governments.

By 2026, only three campuses remained, serving 628 children with 72 teachers.

Table 2: Transformation of the Author's Kindergarten Network (2022–2026)

Indicator	2022	2026
kindergartens	9	3
children	2569	628
Teachers	269	72

This experience fundamentally shaped my understanding of educational transformation.

It has been experienced:

• Industry expansion
• Pandemic disruption
• Demographic decline
• Public sector competition
• Digital transformation
• AI-enabled organizational change

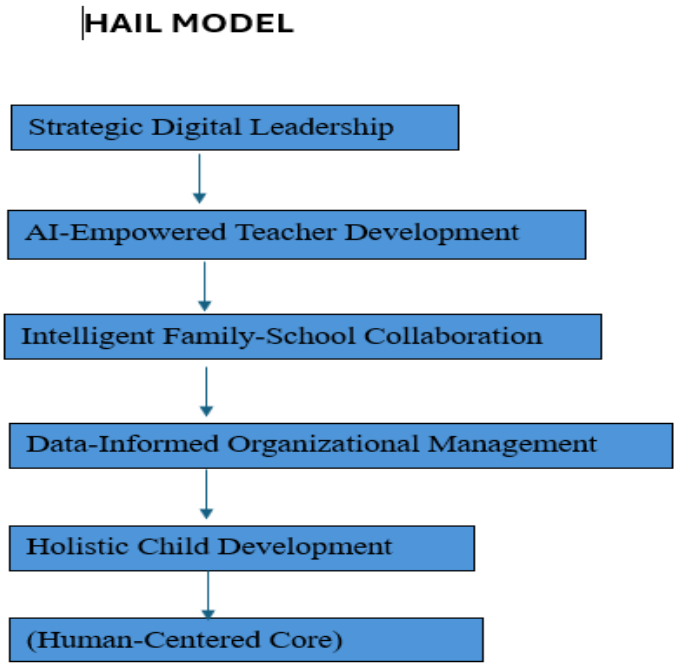
These experiences form the foundation of the Human-Centered AI Leadership Model proposed in this paper.

Analysis

The Human-Centered AI Leadership (HAIL) Model

The HAIL Model identifies five dimensions of successful educational transformation.

Human-Centered AI Leadership (HAIL) Model



Dimension 1: Strategic Digital Leadership

Kindergarten principals must evolve from administrative managers into strategic digital leaders.

Leadership responsibilities now include:

- Digital vision development
- AI implementation planning
- Innovation culture building
- Ethical technology governance

Without leadership transformation, AI adoption remains fragmented and unsustainable.

Dimension 2: AI-Empowered Teacher Development

The organization implemented comprehensive AI training for all principals, teaching directors, and teachers.

Teachers learned to use:

- ChatGPT
- DeepSeek
- Doubao
- Yuanbao
- CapCut AI
- Dreamina AI
- Sponge Music

AI became integrated into:

- Lesson planning
- Growth portfolios
- Classroom activities
- Parent communication
- Educational content production

Teachers reported significant reductions in administrative workload and increased time available for direct interaction with children.

Dimension 3: Intelligent Family-School Collaboration

AI-supported communication systems strengthened family engagement.

Teachers used AI to:

- Generate individualized child reports
- Create personalized birthday songs
- Produce family communication materials
- Generate parent newsletters

Parent satisfaction consistently exceeded 90%.

The findings indicate that AI can enhance relationships when used to support meaningful communication.

Dimension 4: Data-Informed Organizational Management

AI transformed organizational management across multiple campuses.

Administrative systems automated:

- Attendance tracking
- Inventory management
- Payroll support

• Safety inspections
• Meeting documentation
• Performance evaluation

Management workload decreased significantly while operational consistency improved.

Dimension 5: Holistic Child Development

The core principle of the HAIL Model is that AI must serve children's holistic development.

AI can support:

• Documentation
• Communication
• Planning
• Assessment

However, AI cannot replace:

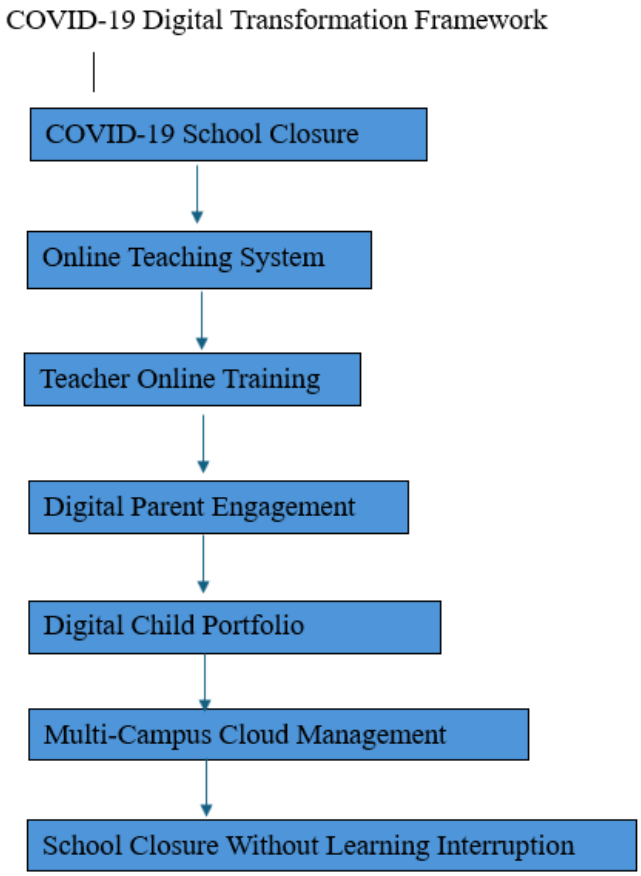
• Emotional attachment
• Empathy
• Play
• Human relationships
• Moral development

The future of kindergarten education remains fundamentally human-centered.

Case Study One:

Digital Transformation During the COVID-19 Pandemic

During repeated kindergarten closures caused by COVID-19 restrictions, our rganization established a comprehensive online education and management system.

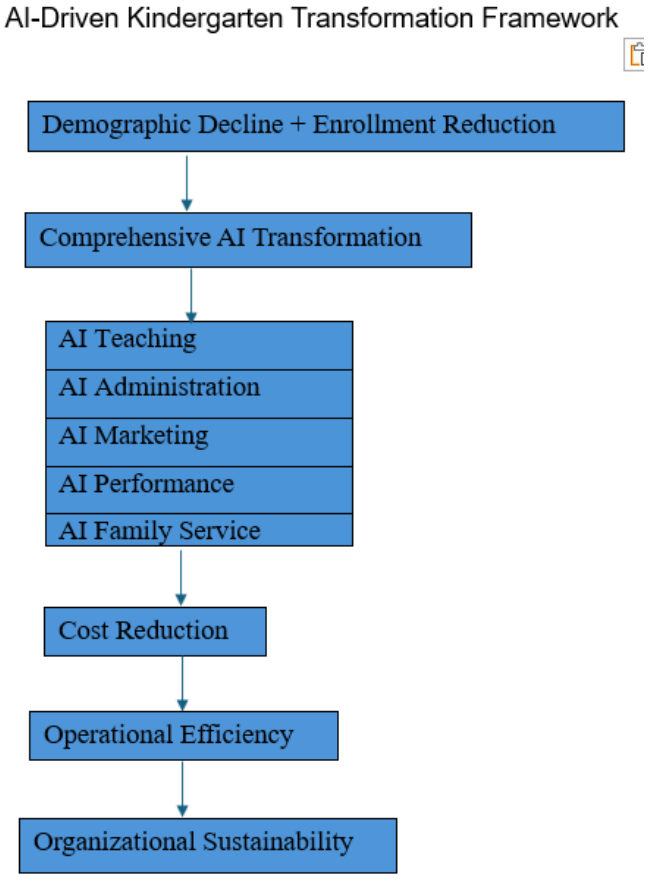


The system replicated the complete daily kindergarten schedule.

Children participated in:
• Online morning exercises
• Thematic learning activities
• Art and music sessions
• Storytelling activities
• Interactive games
• Family learning projects
Teachers collected photos and videos submitted by parents and integrated them into digital growth portfolios.

At the same time:
• Weekly parent activities were organized online
• Teacher training continued through digital platforms
• Multi-campus management was conducted remotely
• Children's developmental records remained uninterrupted
The organization successfully achieved:
"School Closure Without Learning Interruption."
This experience later became the foundation for AI-supported educational management.

Case Study Two
AI Transformation Under Demographic Decline
Following the pandemic, private kindergartens faced a new crisis.



Enrollment declined dramatically due to falling birth rates and expanding public kindergarten provision. To remain sustainable, the organization launched a comprehensive AI transformation strategy.
Major initiatives included:
AI Teaching

Teachers use AI for lesson planning, educational resources, growth portfolios, observation records, family communication, and classroom content development.

AI Administration
Voice-to-text systems automatically generate reports, meeting minutes, and operational documentation.

AI Performance Management
Attendance, teaching quality, family engagement, and child development documentation are automatically tracked and analyzed.

AI Recruitment and Marketing
AI-generated content supports daily promotion through TikTok, Xiaohongshu, WeChat, Bilibili, and livestreaming platforms.
AI Family Services

Findings and Discussion

Parents receive automated educational resources, personalized child updates, and 24-hour intelligent consultation support.

Table 3 AI Applications in Kindergarten Management

Area	AI Applications
Teaching	Lesson planning, growth portfolios, observation records
Administration	Meeting minutes, reports, operational documentation
Family Communication	Parent newsletters, birthday songs, child reports
Performance Evaluation	Attendance, engagement, portfolio completion
Marketing	TikTok, Xiaohongshu, WeChat, livestreaming
Safety Management	AI monitoring and behavior recognition
Resource Management	Inventory, purchasing and consumption tracking

The results include:
Table 4 Outcomes of AI Transformation

Indicator	Result
Administrative workload	Reduced by more than 60%
AI-generated videos	More than 90 per month
Parent satisfaction	Above 90%
Referral conversion rate	Above 30%
Staff AI competency	100% staff trained
Digital child portfolios	100% coverage

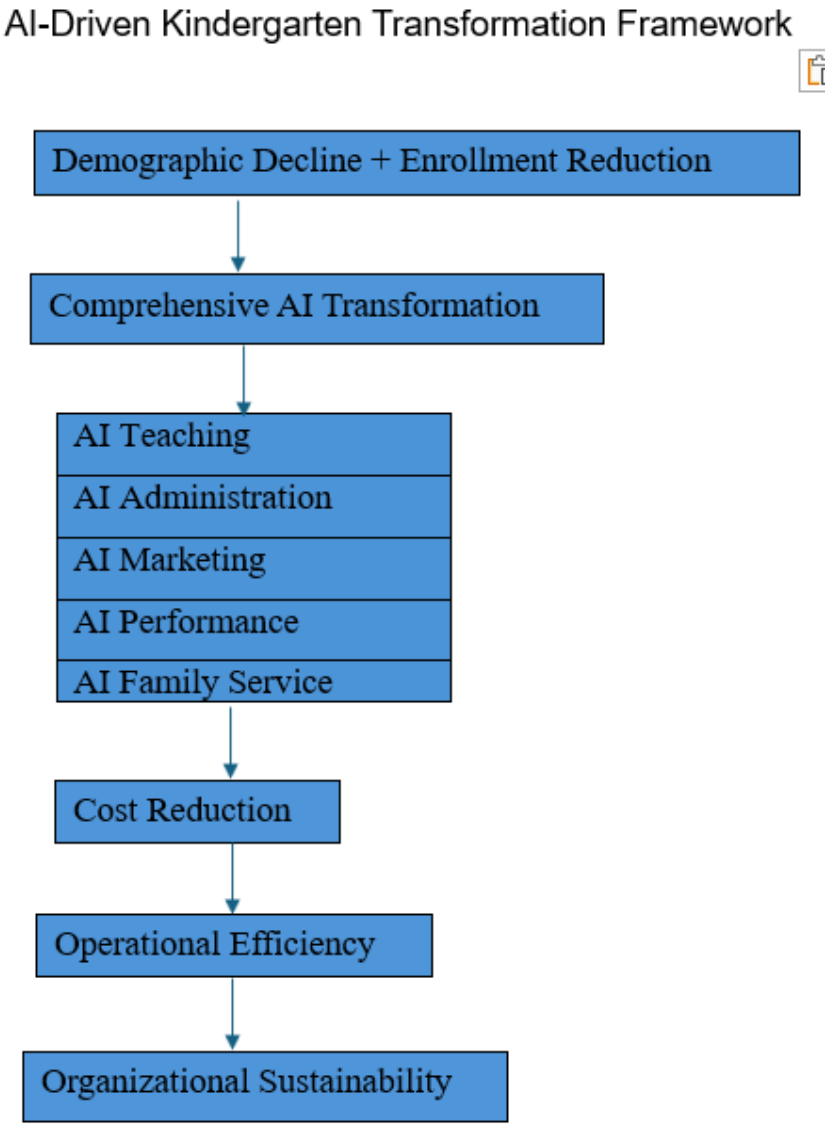
The findings suggest that AI has become a critical strategic tool for organizational sustainability.

This study challenges technology-centered narratives that portray AI as replacing educators. Instead, AI should be viewed as an amplifier of educational leadership.
The HAIL Model demonstrates that successful transformation depends upon balancing:

• Technological innovation
• Human relationships
• Educational ethics
• Organizational sustainability

The findings are particularly relevant for private kindergartens facing demographic decline and increasing competition.

Artificial Intelligence is transforming education globally.
However, technology alone cannot solve the challenges facing early childhood education. Drawing upon twenty years of kindergarten leadership experience, this study proposes the Human-Centred AI Leadership (HAIL) Model as a framework for sustainable educational transformation.



Conclusion

The experiences documented in this paper demonstrate that AI can:

- Reduce operational costs
- Improve teaching efficiency
- Strengthen family engagement
- Enhance management quality
- Support teacher development

Most importantly, AI can help educational organizations remain sustainable during periods of significant uncertainty.

The future of kindergarten leadership lies not in choosing between technology and humanity, but in integrating both to create more effective, ethical, and child-centered educational environments.

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The Impact of Artificial Intelligence on Educational Management

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Abstract

The rapid development of artificial intelligence (AI) has significantly transformed various sectors, including education. In recent years, educational institutions have increasingly adopted AI technologies to enhance management efficiency and improve decision-making processes. This study aims to explore the impact of AI on educational management in higher education institutions. Specifically, it examines how AI tools support administrative functions, strategic planning, student performance monitoring, and institutional development. This study adopts a qualitative research approach through literature review and secondary data analysis. Academic journals, institutional reports, conference papers, and online educational publications related to AI and educational management were systematically reviewed. The collected data were analyzed using thematic analysis to identify key themes, applications, opportunities, and challenges associated with AI implementation in educational institutions. The findings indicate that AI significantly improves administrative efficiency by automating routine tasks, supporting predictive analytics, enhancing communication systems, and improving institutional decision-making. AI technologies also contribute to better resource allocation, student retention, and academic planning. However, challenges such as data privacy concerns, ethical issues, lack of technical expertise, financial limitations, and resistance to technological change remain important barriers to effective implementation. The study concludes that AI plays a crucial role in transforming educational management in higher education institutions. Educational organizations should invest in technological infrastructure, staff training, and policy development to maximize the benefits of AI while minimizing potential risks. Future research should focus on empirical investigations and comparative studies to further evaluate the long-term effectiveness of AI in educational management.

Keywords: Artificial Intelligence, Decision-Making, Digital Transformation, Educational Management, Higher Education

Introduction

Sustainable Artificial intelligence (AI) has become one of the most influential technological innovations of the twenty-first century. AI refers to computer systems and technologies capable of performing tasks that normally require human intelligence, including problem-solving, data analysis, decision-making, language processing, and pattern recognition. Rapid developments in machine learning, big data analytics, and automation have accelerated the integration of AI into many industries such as healthcare, finance, transportation, manufacturing, and education.

The education sector has experienced significant transformation due to the increasing use of digital technologies. Educational institutions are now required to adapt to rapidly changing technological environments while maintaining educational quality, operational efficiency, and institutional competitiveness. Higher education institutions, in particular, face increasing pressure to manage growing student populations, improve learning outcomes, optimize administrative processes, and ensure effective resource allocation. Traditional management approaches are often insufficient to handle these complex challenges efficiently.

Review of Related Literature

As a result, educational institutions have increasingly adopted AI technologies to support educational management and institutional administration. AI applications in educational management include automated administrative systems, predictive analytics, intelligent scheduling systems, student performance monitoring, chatbot services, virtual learning assistants, and data-driven decision-making systems. These technologies enable institutions to process large amounts of information efficiently, improve organizational performance, and enhance communication among stakeholders.

The integration of AI into educational management offers several potential advantages. AI systems can reduce administrative workload by automating repetitive tasks such as attendance tracking, admission processing, timetable management, and student inquiries. In addition, AI technologies can analyze institutional data to identify trends, predict student performance, and support strategic planning. Educational administrators can use AI-generated insights to make informed decisions regarding resource allocation, curriculum development, and student support services.

Furthermore, AI technologies contribute to improved student experiences and institutional effectiveness. Personalized learning systems, adaptive educational platforms, and intelligent tutoring systems can support individual student needs and learning styles. AI-driven analytics also help institutions identify students at risk of academic failure or dropout, allowing administrators and educators to implement early intervention strategies.

Despite these advantages, the implementation of AI in educational management also presents significant challenges. Ethical concerns related to data privacy, surveillance, and algorithmic bias remain major issues in educational institutions. Many institutions also face financial limitations, insufficient technological infrastructure, and lack of professional expertise necessary for successful AI implementation. Resistance to technological change among administrators, teachers, and staff may further slow the adoption process.

Existing research has widely discussed AI applications in teaching and learning; however, limited studies have focused specifically on the role of AI in educational management and institutional administration. Many studies emphasize technological innovation in classrooms while paying less attention to administrative systems and management processes. Therefore, there is a need for further research exploring how AI technologies influence educational management practices in higher education institutions.

Objectives

This study aims to examine the impact of AI on educational management in higher education institutions. The objectives of this study are:

- To identify major applications of AI in educational management.
- To analyze the benefits of AI implementation in higher education institutions.
- To examine the challenges and limitations associated with AI adoption.
- To provide recommendations for effective AI implementation in educational management.

The study contributes to the growing body of literature on digital transformation in education by providing a comprehensive analysis of AI applications in educational management. The findings may assist policymakers, educational administrators, and institutional leaders in understanding the opportunities and challenges associated with AI implementation.

Methodology

Concept of Artificial Intelligence

Artificial intelligence refers to the ability of computer systems to perform tasks that normally require human intelligence. According to Russell and Norvig (2021), AI involves the development of intelligent systems capable of learning, reasoning, and problem-solving. AI technologies include machine learning, natural language processing, robotics, neural networks, and predictive analytics. Machine learning is one of the most widely used AI technologies in education. It enables computer systems to learn from data and improve performance without explicit programming. Educational institutions use machine learning algorithms to analyze student performance, predict learning outcomes, and identify institutional trends.

Natural language processing allows AI systems to understand and respond to human language. This technology is widely used in educational chatbots, virtual assistants, and automated communication systems. Predictive analytics enables institutions to forecast future outcomes based on historical data, supporting strategic planning and institutional decision-making.

AI technologies continue to evolve rapidly, and their applications in education are becoming increasingly sophisticated. Universities and educational organizations now rely on AI systems not only for academic purposes but also for institutional management and policy planning. This demonstrates the growing importance of AI in modern educational environments.

Educational Management in Higher Education

Educational management refers to the administration and organization of educational institutions to achieve educational goals effectively and efficiently. It includes planning, organizing, coordinating, monitoring, and evaluating institutional activities. Effective educational management is essential for maintaining academic quality, operational efficiency, and institutional sustainability.

Higher education institutions face increasing challenges related to student enrollment, financial management, quality assurance, technological development, and global competition. Educational administrators are responsible for managing resources,

supporting academic staff, improving student outcomes, and ensuring compliance with institutional policies.

The digital transformation of higher education has significantly influenced educational management practices. Universities and colleges increasingly rely on digital systems for administrative operations, communication, data management, and academic planning. AI technologies have emerged as important tools for improving institutional efficiency and supporting evidence-based decision-making.

Modern educational management also requires institutions to respond quickly to changing social and technological conditions. Students increasingly expect efficient digital services, personalized learning experiences, and flexible educational environments. Consequently, institutions must adopt innovative technologies to remain competitive and sustainable.

AI Applications in Educational Management

AI technologies are increasingly used in educational management to improve operational efficiency and institutional performance. One major application is predictive analytics. Universities use predictive models to analyze student data and identify students at risk of academic failure or dropout. Early identification allows institutions to provide targeted support and improve student retention.

Another important application is automated administrative systems. AI technologies can automate repetitive administrative tasks such as admissions processing, timetable scheduling, payroll management, attendance monitoring, and document processing. Automation reduces human error, saves time, and improves operational efficiency. AI is also widely used in communication management. Educational institutions use AI-powered chatbots and virtual assistants to provide instant responses to student inquiries regarding admissions, registration, financial aid, and academic services. These systems improve communication efficiency and enhance student satisfaction.

Furthermore, AI technologies support strategic planning and decision-making in higher education institutions. Data analytics systems help administrators analyze institutional performance, evaluate resource allocation, and identify areas for improvement. AI-driven insights enable institutions to make informed decisions based on accurate and real-time data.

In addition, AI technologies are increasingly integrated into learning management systems. These systems help institutions monitor student participation, evaluate learning progress, and provide personalized recommendations. Intelligent learning systems also support online and hybrid learning environments, which became especially important after the COVID-19 pandemic.

Benefits of AI in Educational Management

Several studies have identified significant benefits associated with AI implementation in educational management. One major advantage is improved efficiency. AI systems can process large amounts of information quickly and accurately, reducing administrative workload and improving productivity.

AI technologies also support data-driven decision-making. Educational administrators can use predictive analytics and institutional data to identify trends, evaluate

performance, and develop effective policies. Evidence-based decision-making contributes to better institutional planning and resource management. Another important benefit is improved student support. AI systems can monitor student engagement, academic performance, and attendance patterns to identify students requiring additional assistance. Personalized support strategies may improve student retention and academic success.

Cost reduction is another advantage of AI implementation. Although initial investment costs may be high, automation can reduce long-term operational expenses by minimizing manual administrative work and improving resource utilization. AI technologies also improve institutional responsiveness. Educational institutions can respond more effectively to student needs, policy changes, and external challenges through real-time data analysis and intelligent management systems. This improves organizational flexibility and competitiveness.

Moreover, AI supports innovation in higher education institutions. Universities that adopt advanced technologies are often viewed as modern and forward-looking institutions, which may improve their reputation and attract international students and academic partnerships.

Challenges of AI Implementation

Despite its advantages, AI implementation in educational management presents several challenges. Data privacy and security concerns are among the most significant issues. Educational institutions collect large amounts of sensitive student information, and improper data management may result in privacy violations and ethical concerns. Algorithmic bias is another important challenge. AI systems rely on historical data, and biased data may produce unfair or discriminatory outcomes. Institutions must ensure that AI algorithms are transparent, fair, and ethically designed.

Lack of technical expertise also affects AI implementation. Many educational institutions face difficulties in adopting AI technologies due to limited staff knowledge and insufficient training opportunities. Professional development programs are necessary to improve technological competence among administrators and educators. Financial limitations and inadequate infrastructure may further restrict AI adoption, particularly in developing countries. Institutions may lack sufficient funding to invest in advanced technological systems, software, and technical support. Resistance to technological change is another barrier. Some administrators, teachers, and staff may be reluctant to adopt AI technologies due to concerns about job displacement, increased workload, or unfamiliarity with digital systems.

In addition, ethical concerns regarding surveillance and data monitoring continue to attract attention from researchers and policymakers. Excessive dependence on AI systems may reduce human interaction and create concerns regarding institutional transparency and accountability.

Analysis

Theoretical Framework

This study is guided by the Technology Acceptance Model (TAM), which explains how users accept and adopt new technologies. According to Davis (1989), perceived

usefulness and perceived ease of use influence individuals' willingness to adopt technological systems.

In the context of educational management, administrators and institutional staff are more likely to adopt AI technologies if they believe the systems improve efficiency, enhance decision-making, and are easy to use. Institutional support, training opportunities, and technological infrastructure also influence technology acceptance.

The TAM framework is relevant to this study because it helps explain the factors influencing AI adoption in educational management. Understanding these factors may assist institutions in developing effective implementation strategies.

The model also highlights the importance of user attitudes toward technology. Educational institutions that provide training, technical support, and positive organizational environments are more likely to achieve successful AI implementation. Therefore, technology acceptance is influenced not only by technological quality but also by institutional culture and leadership support.

Research Design

This study employs a qualitative research design based on literature review and secondary data analysis. A qualitative approach is appropriate because it allows the researcher to explore existing knowledge, identify recurring themes, and analyze the broader impact of AI technologies on educational management.

Qualitative research is widely used in educational studies because it provides detailed understanding of social and organizational phenomena. In this study, the qualitative approach helps explain how AI technologies influence institutional administration, management practices, communication systems, and decision-making processes in higher education institutions.

The study focuses on higher education institutions and examines how AI technologies influence administrative processes, strategic planning, resource allocation, student management, and institutional performance.

Data Collection

Secondary data were collected from academic journals, conference proceedings, books, institutional reports, and online educational publications. The literature search focused on publications related to AI, educational management, digital transformation, higher education administration, and technology adoption.

Relevant articles published between 2018 and 2025 were selected to ensure the inclusion of recent developments and current technological trends. Online databases such as Google Scholar, Scopus, ResearchGate, SpringerLink, and educational research journals were used as primary sources of information.

- Keywords used during the literature search included:
- Artificial Intelligence in Education
- Educational Management
- Higher Education Administration
- AI and Decision-Making

- Digital Transformation in Education
- Predictive Analytics in Universities
- AI-based Administrative Systems
- Technology Adoption in Higher Education

The selected literature was carefully reviewed to identify major themes, benefits, challenges, and implementation strategies associated with AI in educational management. The researcher selected sources based on relevance, publication quality, academic credibility, and consistency with the objectives of the study. Peer-reviewed journal articles and official institutional publications were prioritized to ensure reliability and validity.

Inclusion and Exclusion Criteria

To improve the quality of the literature review, specific inclusion and exclusion criteria were applied during data selection.

Inclusion Criteria

The study included literature that:

- Focused on AI applications in education or educational management.
- Discussed higher education institutions.
- Examined administrative systems, institutional management, or decision-making processes.
- Was published between 2018 and 2025.
- Was written in English.
- Came from academic journals, books, conference papers, or official institutional reports.

Exclusion Criteria

- The study excluded literature that:
- Focused only on primary or secondary school education.
- Discussed AI in unrelated industries without educational relevance.
- Lacked academic credibility or sufficient methodological information.
- Was duplicated across databases.
- Was published before 2018 unless considered highly influential.
- Applying these criteria helped ensure that the selected sources were relevant, recent, and academically reliable.

Data Analysis

The collected data were analyzed using thematic analysis. Thematic analysis is a qualitative method used to identify recurring patterns, concepts, and themes within data.

The analysis process involved the following steps:

- Reading and reviewing selected literature.
- Identifying key concepts and recurring themes.
- Categorizing findings into thematic areas.
- Comparing findings across different studies.
- Synthesizing results to develop conclusions.
- The analysis focused on four major themes:
- AI applications in educational management.

- Benefits of AI implementation.
- Challenges and limitations.
- Recommendations for effective implementation.

The researcher compared findings from different studies to identify similarities and differences regarding AI implementation in educational institutions. This comparative approach improved the comprehensiveness of the analysis.

Thematic analysis was selected because it allows flexibility in examining complex educational and technological issues. It also helps organize large amounts of qualitative information into meaningful categories.

Reliability and Validity

To improve reliability and validity, the study used multiple academic sources from reputable journals and institutional publications. Relevant studies from different geographical regions were included to provide broader perspectives on AI implementation in educational management.

The researcher also compared findings from various studies to ensure consistency and reduce bias in data interpretation. Information from different authors and institutions was cross-checked to confirm reliability.

In addition, the use of peer-reviewed academic literature strengthened the credibility of the findings. The inclusion of recent studies ensured that the analysis reflected current technological developments and educational trends.

Ethical Considerations

This study is based entirely on secondary data and does not involve direct human participants. Therefore, no personal or confidential information was collected.

All referenced materials were properly cited according to APA referencing guidelines to avoid plagiarism and ensure academic integrity. The study also considered ethical concerns associated with AI technologies, including data privacy, transparency, fairness, and responsible technology use.

The researcher aimed to present findings objectively and avoid bias during analysis and interpretation.

Limitations of the Study

Although this study provides valuable insights into AI implementation in educational management, several limitations should be acknowledged.

First, the study relies entirely on secondary data and literature review. Therefore, the findings are dependent on the quality and availability of existing research. The study does not include primary empirical data collected from universities or educational administrators.

Second, the rapid development of AI technologies means that some information may become outdated quickly. Educational technologies continue to evolve, and future developments may influence current conclusions. Third, the study mainly focuses on

higher education institutions and may not fully represent AI implementation in primary or secondary education sectors. Despite these limitations, the study provides a comprehensive overview of current AI applications, benefits, challenges, and future implications in educational management.

Findings and Discussion

AI Applications in Educational Management

The findings indicate that AI technologies are increasingly integrated into educational management systems in higher education institutions. Universities and colleges use AI applications to improve operational efficiency, enhance decision-making, and support institutional development.

The literature demonstrates that AI implementation has become an important component of digital transformation strategies in many universities worldwide. Educational institutions increasingly recognize the importance of AI technologies in managing complex administrative systems and improving institutional effectiveness.

Administrative Automation

One of the most significant applications of AI in educational management is administrative automation. Educational institutions increasingly use AI systems to automate repetitive administrative tasks such as:

- Student admissions processing
- Attendance monitoring
- Timetable scheduling
- Payroll management
- Examination processing
- Student registration systems
- Document management
- Email response systems

Automation reduces administrative workload and minimizes human errors. Institutions can process information more efficiently, allowing administrators and staff to focus on strategic and academic responsibilities.

For example, AI-based scheduling systems can automatically generate class timetables while considering classroom availability, lecturer schedules, and student enrollment patterns. This significantly reduces the time required for manual scheduling.

In many universities, automated admission systems can process student applications, verify documents, and communicate application results within a shorter time compared to traditional methods. These improvements contribute to greater efficiency and improved service quality. AI-based administrative systems also reduce paperwork and support environmentally sustainable institutional practices by promoting digital document management systems.

Predictive Analytics and Student Monitoring

Predictive analytics is another important AI application identified in the literature. Universities use predictive models to analyze student data and forecast academic outcomes.

AI systems can identify students at risk of academic failure or dropout by analyzing factors such as:

- Attendance records
- Assessment performance
- Online learning participation
- Assignment completion rates
- Student engagement levels
- Learning behavior patterns

Early identification allows institutions to implement intervention strategies such as academic counseling, tutoring programs, mentoring services, and additional academic support. Several studies indicate that predictive analytics contributes to improved student retention and academic performance. Educational administrators can use data-driven insights to develop targeted support programs and improve institutional effectiveness.

For example, universities may use AI systems to identify first-year students facing adaptation difficulties and provide early academic guidance. This proactive approach improves student success rates and reduces dropout rates. Predictive analytics also supports institutional planning by helping universities forecast enrolment trends, graduation rates, and future academic demand.

AI-Powered Communication Systems

AI technologies are also widely used in institutional communication systems. Chatbots and virtual assistants are increasingly implemented to support communication between students, administrators, and academic staff.

AI-powered chatbots provide instant responses to common student inquiries regarding:

- Admission requirements
- Registration procedures
- Course information
- Tuition fees
- Examination schedules
- Financial aid services
- Campus facilities
- Student activities

These systems improve communication efficiency and reduce the workload of administrative staff. Students can access information at any time without waiting for office hours. In addition, AI communication systems improve student satisfaction by providing faster responses and continuous support services. Many universities now integrate chatbot systems into institutional websites and mobile applications. Virtual assistants may also help staff organize meetings, manage schedules, and automate communication processes. This improves organizational coordination and time management.

Resource Allocation and Strategic Planning

AI technologies support institutional planning and resource management through advanced data analytics. Educational institutions use AI systems to analyze institutional performance and optimize resource allocation.

Administrators can use AI-generated insights to:

- Forecast student enrollment trends
- Manage budgets effectively
- Allocate teaching resources
- Improve classroom utilization
- Evaluate institutional performance
- Plan future academic programs
- Support long-term strategic planning

Strategic planning becomes more effective when administrators have access to accurate and real-time data.

AI systems also help institutions identify areas requiring improvement. For example, universities may analyze student feedback and academic performance data to evaluate teaching quality and curriculum effectiveness.

Furthermore, AI-driven analytics can support financial planning by identifying spending patterns and resource inefficiencies. This enables institutions to improve budget management and reduce unnecessary operational costs.

Benefits of AI in Educational Management

The analysis identified several important benefits associated with AI implementation in educational management.

Improved Efficiency

One of the most significant benefits of AI is improved operational efficiency. AI systems automate routine administrative tasks, reducing processing time and minimizing manual work.

Automation allows institutions to manage large volumes of data more effectively while improving service quality. Administrative staff can focus on higher-level tasks such as policy development, strategic planning, and student support. For example, AI-based systems can automatically process student attendance data and generate reports within seconds. This significantly reduces administrative workload and improves accuracy.

The efficiency of AI systems also contributes to faster institutional decision-making and improved organizational responsiveness.

Better Decision-Making

AI technologies enhance institutional decision-making by providing accurate and data-driven insights. Educational administrators can analyze institutional trends, evaluate performance indicators, and identify areas requiring improvement.

Predictive analytics helps institutions make informed decisions regarding:

- Student retention strategies
- Academic program development
- Resource allocation
- Financial planning
- Institutional growth

- Staff recruitment
- Curriculum planning

Evidence-based decision-making improves institutional effectiveness and long-term planning.

Administrators can use AI-generated reports and dashboards to monitor institutional performance in real time. This improves transparency and accountability in educational management.

Enhanced Student Support

AI technologies contribute to improved student experiences and support services. Personalized learning systems and predictive analytics enable institutions to provide targeted assistance to students. AI systems can identify students facing academic difficulties and recommend appropriate interventions. Personalized support contributes to improved academic performance and higher student satisfaction.

For example, learning management systems may recommend additional learning materials based on individual student performance and learning behaviour. AI technologies also support inclusive education by helping institutions identify students with special educational needs and provide appropriate support services.

Cost Reduction

Although AI implementation may require substantial initial investment, automation reduces long-term operational costs. Institutions can minimize manual administrative work, reduce paperwork, and improve resource utilization. Digital systems also reduce dependency on physical infrastructure and manual record management. For example, universities using digital administrative systems may reduce printing costs, document storage expenses, and administrative staffing requirements.

Cost reduction improves institutional sustainability and financial efficiency**.**

Improved Institutional Competitiveness

Universities adopting AI technologies may strengthen their competitiveness in the global education sector. Technological innovation enhances institutional reputation and attracts students seeking modern educational environments. AI-driven systems also improve institutional responsiveness and adaptability in rapidly changing educational environments.

Institutions that successfully implement AI technologies may gain competitive advantages through:

- Improved service quality
- Better student experiences
- Stronger institutional reputation
- Increased operational efficiency
- Enhanced research and innovation capabilities

Global competition in higher education encourages institutions to adopt advanced technologies to maintain relevance and sustainability.

Challenges and Limitations of AI Implementation
Despite the benefits, several challenges associated with AI implementation were identified.

Data Privacy and Security Concerns
Data privacy remains one of the most significant concerns in educational AI systems. Educational institutions collect large amounts of sensitive student information, including academic records, personal details, financial data, and behavioural information.

Improper management of data may result in:

- Privacy violations
- Unauthorized access
- Cybersecurity threats
- Ethical concerns
- Identity theft risks

Institutions must establish strong data protection policies and ensure compliance with legal regulations.

Educational organizations should also implement cybersecurity systems to protect institutional databases from cyberattacks and unauthorized access.

Lack of Technical Expertise
Many educational institutions face difficulties in implementing AI technologies due to insufficient technical expertise. Administrators, teachers, and staff may lack the necessary knowledge and skills to operate AI systems effectively.

Professional training and continuous development programs are essential for successful AI adoption. Without adequate technical support, institutions may experience implementation difficulties, system errors, and reduced efficiency.

Training programs should focus on digital literacy, AI system management, data analysis, and ethical technology use.

Financial Limitations
AI implementation often requires significant financial investment in:

- Technological infrastructure
- Software systems
- Technical support
- Staff training
- Data management systems
- Cybersecurity protection

Institutions with limited financial resources may struggle to adopt advanced AI technologies.

This challenge is especially significant for smaller universities and institutions in developing countries where financial resources are limited. High implementation costs may delay digital transformation initiatives and widen technological inequality among institutions.

Resistance to Technological Change

Resistance to change is another major challenge identified in the literature. Some educational staff may fear job displacement or increased workload resulting from technological changes.

Lack of confidence in AI systems may also reduce acceptance and adoption rates. Some educators and administrators may prefer traditional management systems because they are more familiar and easier to control. Resistance may also result from concerns regarding the reliability and fairness of AI technologies. Employees may worry that automated systems could reduce human interaction and negatively affect institutional culture.

Educational institutions should therefore promote positive attitudes toward technological innovation through training, communication, and organizational support.

Ethical Issues and Algorithmic Bias

AI systems may produce biased outcomes if algorithms are trained using incomplete or biased data. Biased decision-making may negatively affect student evaluations, admissions processes, and institutional policies.

Educational institutions must ensure transparency, fairness, and ethical standards in AI implementation.

Ethical concerns regarding AI technologies include:

- Algorithmic discrimination
- Lack of transparency
- Overdependence on automated systems
- Reduced human judgment
- Surveillance concerns

Institutions should establish ethical review procedures and monitoring systems to ensure responsible AI usage. In addition, policymakers and educational leaders should develop clear regulations regarding AI governance and accountability in educational environments.

Comparative Summary of AI Applications in Educational Management

Table 1 Presents a Summary of Major AI Applications, Benefits, and Challenges Identified in the Literature.

AI Application	Main Function	Benefits	Challenges
Predictive Analytics	Student performance prediction	Improved retention and academic support	Data privacy concerns
Automated Administration	Registration, scheduling, attendance	Reduced workload and improved efficiency	High implementation cost

Chatbots and Virtual Assistants	Student communication support	Faster response and improved satisfaction	Limited human interaction
Resource Allocation Systems	Budgeting and planning	Better institutional planning	Dependence on accurate data
Learning Analytics	Monitoring student engagement	Personalized support strategies	Ethical concerns regarding surveillance

Source: Developed by the researcher based on literature review.

The findings demonstrate that AI technologies have substantial potential to transform educational management in higher education institutions. AI systems improve operational efficiency, support strategic planning, and enhance institutional decision-making.

The results are consistent with previous studies emphasizing the importance of digital transformation in higher education. Educational institutions increasingly recognize the value of data-driven management systems and predictive analytics. AI technologies provide opportunities for institutions to improve service quality, optimize administrative processes, and support evidence-based planning. Automated systems help institutions reduce operational inefficiencies and improve organizational coordination. Furthermore, AI technologies improve institutional adaptability in rapidly changing educational environments. Universities adopting AI systems are better positioned to respond to student expectations, technological trends, and global educational competition. However, successful AI implementation requires more than technological investment. Institutions must also address organizational, ethical, and human resource challenges. Educational leaders play a critical role in promoting AI adoption and creating supportive institutional environments. Leadership commitment, staff training, policy development, and technological support are essential for effective implementation.

In addition, institutions should establish ethical guidelines and regulatory frameworks to ensure responsible AI use. Transparency, accountability, and data protection must remain central priorities in educational AI systems. The findings also indicate that AI technologies should support rather than replace human decision-making. Educational management involves human relationships, ethical judgment, and organizational culture, which cannot be fully automated. Therefore, a balanced approach combining technological innovation and human-centered leadership is necessary for sustainable educational development.

Future Implications of AI in Educational Management

The role of AI in educational management is expected to continue expanding in the coming years. Rapid technological advancement and increasing digitalization in higher education will likely encourage institutions to adopt more advanced AI systems.

Universities may increasingly rely on AI-driven decision-making models to improve institutional planning, financial management, and student support services.

One important future trend is the integration of generative AI technologies into educational administration. Generative AI systems may assist educational institutions in

preparing reports, analyzing institutional data, developing strategic plans, and improving communication processes.

AI tools may also help administrators identify emerging educational trends and respond quickly to institutional challenges.
Another future implication involves personalized educational management systems. AI technologies may allow institutions to develop highly individualized student support systems based on behavioral data, academic performance, and learning preferences.

This may contribute to improved learning outcomes and greater student engagement.
Smart campus development is also expected to become more common in higher education institutions. AI-powered smart campuses may integrate:

- Digital attendance systems
- Automated security systems
- Intelligent classroom management
- Energy-efficient resource management
- Smart transportation systems
- Real-time institutional monitoring

These technologies could improve operational efficiency while reducing institutional costs.

However, future AI implementation will also require stronger ethical governance and policy frameworks. Governments and educational institutions must establish regulations regarding data protection, algorithm transparency, and responsible AI usage. Institutions must ensure that AI systems are used fairly and do not create discrimination or inequality among students. In addition, human-centered leadership will remain important despite increasing automation. Educational administrators must balance technological innovation with human values, emotional intelligence, and ethical decision-making. AI technologies should support human decision-making rather than completely replace human judgment.

The future success of AI in educational management will depend on collaboration among policymakers, educational leaders, researchers, and technology developers. Institutions that successfully integrate AI technologies while maintaining ethical and educational standards may achieve greater competitiveness and sustainability in the global education sector.

Recommendations
Based on the findings of this study, several recommendations are proposed for higher education institutions implementing AI technologies.

Investment in Technological Infrastructure
Educational institutions should invest in modern technological infrastructure, including:

- High-speed internet systems
- Secure data management platforms
- AI software applications
- Cloud computing systems
- Cybersecurity protection
- Strong infrastructure is essential for effective AI implementation.

Professional Training and Development

Institutions should provide continuous training programs for administrators, teachers, and technical staff.

- Training should focus on:
- AI system operation
- Data analysis skills
- Digital literacy
- Ethical AI practices
- Cybersecurity awareness

Professional development improves staff confidence and technological competence.

Development of Ethical Policies

Educational institutions should establish clear ethical guidelines regarding:

- Data privacy
- Student consent
- Algorithm transparency
- Responsible AI usage
- Fair decision-making

Ethical policies help reduce risks associated with AI implementation.

Encouraging Institutional Support

University leadership should actively support AI adoption by:

- Promoting innovation
- Providing financial support
- Encouraging collaboration
- Supporting digital transformation initiatives

Institutional support improves technology acceptance and implementation success.

Collaboration with Technology Experts

Educational institutions should collaborate with:

- Technology companies
- AI researchers
- Software developers
- Educational consultants

Collaboration may improve system development and implementation efficiency.

Conclusion

Artificial intelligence has become an important component of modern educational management. The findings of this study indicate that AI technologies significantly improve administrative efficiency, support data-driven decision-making, enhance communication systems, and contribute to institutional development in higher education institutions. AI applications such as predictive analytics, automated administrative systems, intelligent communication platforms, and resource management tools enable educational institutions to improve operational effectiveness and respond more efficiently to institutional challenges. Despite these benefits, several barriers to AI implementation remain. Data privacy concerns, ethical issues, lack of technical expertise, financial limitations, and resistance to technological change continue to affect the adoption

process. Successful AI implementation requires comprehensive institutional strategies, technological investment, staff training, ethical guidelines, and strong leadership support. Educational institutions must ensure that AI systems are implemented responsibly and effectively to maximize their benefits while minimizing potential risks.

This study contributes to the growing literature on AI and educational management by providing a comprehensive analysis of AI applications, benefits, and challenges in higher education institutions. Future research should focus on empirical investigations involving specific universities, comparative studies across countries, and long-term evaluations of AI effectiveness in educational management. As educational environments continue to evolve, AI technologies are expected to play an increasingly important role in shaping the future of educational administration and institutional management.

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Democratizing the Digital Frontier: Strategies for AI Literacy and Equity in Resource -Constrained Educational Settings

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Abstract

Artificial Intelligence (AI) is rapidly transforming global education systems; however, unequal access to digital infrastructure, computational resources, and AI-enabled learning environments has widened the emerging "AI Divide." Students and institutions in resource-constrained educational settings risk exclusion from future academic and economic opportunities due to limited access to advanced AI technologies. This study investigates scalable and inclusive strategies for implementing AI literacy in low-resource environments where high-cost infrastructure and high-speed internet connectivity remain inaccessible. Using qualitative analysis of case studies on frugal innovation, policy documents, and open-source Small Language Models (SLMs), the research proposes a "Low-Bandwidth AI Literacy Framework" designed for equitable AI education. The framework emphasizes mobile-first pedagogy, hardware-agnostic tools, offline-capable AI systems, and critical AI literacy skills, including algorithmic auditing, ethical awareness, and prompt-engineering logic. The findings reveal that meaningful AI competency development does not necessarily depend on premium generative AI platforms or advanced computing ecosystems. Instead, a foundational "Critical AI Agency" can be cultivated through decentralized, accessible, and ethically grounded pedagogical models. The study argues that democratizing AI education requires a transition from resource-intensive implementation toward sustainable, inclusive, and context-sensitive educational strategies. By adopting open-source and low-bandwidth AI ecosystems, educational institutions can promote digital equity, social mobility, and global educational inclusion in the age of Artificial Intelligence.

Keywords: Artificial Intelligence Literacy, Critical AI Agency, Digital Equity, Educational Technology, Low-Bandwidth Learning, Open-Source AI, Resource-Constrained Education, Small Language Models

Introduction

The integration of Artificial Intelligence into educational systems represents one of the most significant pedagogical shifts of the 21st century. From adaptive learning platforms and intelligent tutoring systems to automated assessment tools and generative content engines, AI technologies are reshaping how knowledge is created, delivered and assessed across institutions worldwide (UNESCO, 2023; World Economic Forum, 2023). However, this transformation is far from uniform.

A growing body of literature identifies a structural inequity in the global diffusion of educational technology, now crystallizing into what scholars term the “AI Divide” a stratification in which learners in high-income environments benefit from sophisticated AI-augmented instruction while students in resource-constrained settings are progressively excluded (Selwyn, 2022; Williamson & Hogan, 2020). This divide is not merely technological; it is deeply social, economic and geopolitical.

As AI becomes central to academic and professional ecosystems, students from resource-constrained educational environments risk exclusion from future opportunities. This exclusion may deepen social inequality, restrict workforce participation, and reduce educational mobility. Consequently, democratizing AI literacy has become a global educational imperative.

The present study examines the effective implementation of AI literacy in low-resource educational settings using affordable, accessible, and sustainable approaches. It explores open-source Small Language Models (SLMs), mobile-first pedagogies, and offline-capable AI tools to create inclusive learning ecosystems. Instead of emphasizing costly infrastructure or premium AI subscriptions, the research advocates decentralized educational strategies that prioritize ethical awareness, critical AI thinking, and practical digital participation.

The study develops a “Low-Bandwidth AI Literacy Framework” designed to support educational leaders, policymakers, and teachers in integrating AI education into underserved learning environments. This framework offers practical guidance on implementing accessible AI tools and methodologies that overcome infrastructural and resource limitations, enabling educators to design equitable learning experiences. By focusing on frugal innovation and educational equity, the framework seeks to transform AI from a privilege of technologically advanced institutions into a universally accessible educational resource, thus promoting student inclusion and digital empowerment.

Against this backdrop, the following review of related literature examines the AI divide, frugal innovation in education, emerging small language model ecosystems and AI literacy frameworks that inform the present study.

Review of Related Literature

The AI Divide in Global Education

The concept of the digital divide, first theorized in the late 1990s, has evolved considerably in an era dominated by algorithmic systems and machine learning (Van Dijk, 2020). While early formulations focused on binary access to the internet, contemporary analyses foreground multi-layered inequities encompassing device ownership, data literacy, platform affordability and now, AI competency (ITU, 2022).

In the Indian context, this divide is multi-layered. The Annual Status of Education Report (ASER, 2023) found that while 73.5% of rural households own a smartphone, only 26.2% of government upper-primary schools have functional computers, and fewer than 15% maintain reliable broadband connectivity. The gap between aspiration and infrastructure is significant.

India's AI skills gap has significant economic implications. NASSCOM (2023) projects a shortfall of 1.4 million AI-skilled professionals in India by 2026. Given that Tamil Nadu

alone accounts for over 20% of India's IT exports (STPI, 2023), the capacity gap in school-level AI education has direct labour market consequences felt disproportionately by students in government schools serving Scheduled Caste, Scheduled Tribe, and economically weaker communities.

While the AI divide highlights structural inequities in access and capacity, a parallel body of work points to frugal innovation as a pathway to more inclusive educational technology.

Frugal Innovation and Educational Technology

Core Principles of Frugal Innovation

Unlike traditional innovation, which often relies on massive R&D budgets and high-end tech, frugal innovation follows these rules:

Cost Reduction: Cutting out "nice-to-have" features to focus on the absolute core function.

Robustness: Designing tools that work in harsh environments (e.g., software that works offline or on low-end smartphones).

Accessibility: Ensuring the final product is affordable for the "bottom of the pyramid" (the poorest or most remote populations).

We should not wait for every school to have high speed fibre internet and expensive devices to begin teaching AI.

India has a distinguished tradition of frugal innovation, the deliberate design of solutions that are affordable, simple, and robust under constraints (Radjou and Prabhu, 2015). In educational technology, this tradition has generated internationally recognised models. The Pratham network's Teaching at the Right Level (TaRL) methodology, adopted in 11 Indian states and subsequently replicated across Africa and Southeast Asia, demonstrates that scalable improvements in learning are achievable without high-cost technology (Banerjee et al., 2016).

In Tamil Nadu specifically, the e-Kalvi (e-Education) initiative of the early 2010s pre-loaded offline educational content onto shared government school computers, anticipating the "offline-first" design philosophy that now underlies frameworks such as Learning Equality's Kolibri. The ICT@Schools scheme, implemented across Tamil Nadu government schools with support from ELCOT (Electronics Corporation of Tamil Nadu), established computer labs in over 6,000 schools, though utilisation studies (Subramaniam, 2019) indicate persistent underuse due to teacher capacity gaps and infrastructure unreliability.

More recently, the Naan Mudhalvan scheme, launched by the Tamil Nadu government in 2022, has embedded industry-linked digital and AI skills training for students in Classes IX–XII in government and government-aided schools. The scheme's partnership architecture involving GUVI (Grow, Upskill, Vernacularise, and Innovate), NASSCOM, and Coursera demonstrates the potential of public-private frugal innovation in AI education at scale.

These frugal approaches intersect with emerging AI architectures, particularly small language models that can operate in low resource environments.

Small Language Models and Offline AI Ecosystems

Recent advances in model compression, knowledge distillation, and quantization have significantly reduced the computational footprint of capable language models. Small Language Models (SLMs), such as Microsoft's Phi-3 Mini, Meta's LLaMA variants optimized for edge deployment, and Google's Gemma Nano, now offer meaningful natural language processing capabilities on consumer-grade hardware without internet connectivity (Gunasekar et al., 2023; Touvron et al., 2023). This development has transformative implications for low-resource educational contexts. SLMs can be pre-loaded onto shared tablets, Raspberry Pi devices, or school servers, enabling offline AI interactions for language learning, question answering, and basic programming instruction. Crucially, their lower computational demands reduce energy consumption, making them compatible with solar-powered and intermittent electricity environments.

However, the pedagogical integration of SLMs in low-resource classrooms remains undertheorized. Existing literature predominantly addresses technical benchmarking rather than applied educational design, a gap this study seeks to address. Alongside the technical evolution of small language models, scholars have proposed a range of AI literacy frameworks that guide what learners should know and be able to do with AI.

AI Literacy: Conceptual Frameworks

AI literacy as a field of educational inquiry has grown rapidly, producing a range of definitional and curricular frameworks. Long and Magerko (2020) propose a taxonomy of AI literacy competencies encompassing recognition, application, evaluation, and ethical critique of AI systems. Touretzky et al. (2019) advance a 'Five Big Ideas in AI' framework used in K-12 curricula across multiple countries.

The National Education Policy 2020 explicitly mandates exposure to AI, machine learning, and data science from middle school onwards and calls for the integration of "computational thinking" as a core competency across all school stages (MHRD, 2020). India's National AI Strategy (NITI Aayog, 2018) branded "AI for All" positions inclusive AI access as a national priority, with education identified as one of five strategic sectors. A persistent critique of mainstream AI literacy frameworks, however, is their implicit assumption of resource-rich contexts with full internet access, coding environments, cloud platforms, and sufficient device-to-student ratios. This study argues for an alternative orientation that foregrounds 'Critical AI Agency': the capacity to understand, interrogate, and purposefully engage with AI systems, even in conditions of constrained technological access.

Building on this literature, the study formulates specific objectives and adopts a qualitative research design to develop a context sensitive AI literacy framework for low resource educational settings.

Objectives

The major objectives of the study are:

1. To examine the challenges associated with implementing AI literacy in resource-constrained educational settings.
2. To analyze the role of open-source Small Language Models (SLMs) in democratizing AI education.

3. To investigate frugal innovation strategies suitable for low-bandwidth educational environments.
4. To develop a Low-Bandwidth AI Literacy Framework for inclusive AI education.
5. To explore how critical AI literacy can promote digital equity and social mobility.

To address these objectives, the study adopts a qualitative, interpretivist research design drawing on document analysis, conceptual synthesis, and case study material.

Methodology

Research Design

The study adopts a qualitative research design based on document analysis, conceptual synthesis, and case study evaluation.

Data Sources

The research utilizes secondary data collected from:

- Research articles on AI literacy and digital equity
- UNESCO and OECD educational policy reports
- Open-source AI documentation
- Frugal innovation case studies
- Educational technology reports
- AI implementation studies in developing regions

Method of Analysis

This study adopts an interpretivist qualitative research paradigm, appropriate to the exploratory and context-sensitive nature of the inquiry. Rather than seeking universal generalisations, the research aims to generate conceptually rich, practically actionable propositions for AI literacy design in low-resource environments.
Thematic analysis was employed to identify recurring themes related to:

- Accessibility barriers
- Infrastructure constraints
- Open-source AI deployment
- Mobile-first pedagogy
- thical AI education
- Inclusive digital strategies

Insights generated through this qualitative analysis were synthesised into a practical conceptual model the Low Bandwidth AI Literacy Framework tailored to the constraints of low resource educational environments.

Low-Bandwidth AI Literacy Framework

The proposed framework is designed to support AI literacy implementation in educational settings with limited technological infrastructure.

Core Components of the Framework

Mobile-First Learning

Since smartphones are more accessible than computers in many underserved regions, AI learning activities should be optimized for mobile devices. Mobile-compatible AI tools and lightweight applications can enhance accessibility.

Offline-Capable AI Systems
Offline AI models reduce dependency on continuous internet connectivity. Lightweight Small Language Models (SLMs) can be installed locally on low-end devices for educational purposes.

Open-Source Ecosystem
Open-source AI tools provide affordable alternatives to premium AI platforms. They enable localization, customization, and community-driven educational innovation.

Critical AI Agency
Students should be trained not only to use AI tools but also to critically evaluate algorithmic outputs, identify biases, understand ethical implications, and practice responsible AI engagement.

Hardware-Agnostic Design
Educational AI systems should function across multiple device types, including low-end smartphones, refurbished computers, and community digital centres.

Community-Based Learning
Collaborative AI literacy initiatives involving teachers, local institutions, NGOs, and community centres can expand access and sustainability.

Below are four high impact frugal AI applications currently being used in 2025–2026:

The "Rori" Math Tutor (Low-Data Accessibility)

- An AI math tutor delivered entirely via WhatsApp.
- **Why it's Fruga**l: Instead of requiring a high-end app or a laptop, it works on any basic smartphone. In 2026, it costs only about US$5 per student annually and provides learning gains equivalent to an additional year of schooling in regions such as Ghana.

Offline "Small AI" (Infrastructure Independence)

- Using **Small Language Models** (SLMs)—like specialized versions of Microsoft's Phi or Google's Nano—that are "compressed" to run without an internet connection.
- **Why it's Frugal**: It removes the need for expensive fibre-optic cables or constant 5G. Startups in Bangladesh (e.g., Shikho) are integrating these into mobile apps that function fully offline.

Voice-to-Text Literacy Tools (Hardware Agnostic)

- Tools like the **Oral Reading Fluency (ORF)** assistant are used in thousands of schools in India.
- **Why it's Frugal**: It uses the basic microphone of a cheap smartphone to listen to a child read, providing instant feedback and transcribing data for teachers.
- Table 1. Summary of Literature Reviewed.

Raspberry Pi AI Servers (Low-Cost Hardware)

- Projects using **Raspberry Pi** (tiny $35 computers) to host local AI models for a whole classroom.

- **Why it's Frugal**: It replaces the need for a $1,000 computer lab. One "server" the size of a credit card can provide an entire village school with an AI-powered library and tutoring system.

The following section analyses how these core components address the documented barriers to AI access and literacy and discusses their implications for equitable educational transformation.

Analysis

The findings of the study indicate that meaningful AI literacy does not necessarily require expensive infrastructure or premium generative AI subscriptions. Instead, several low-cost and decentralized strategies can effectively support AI education in underserved environments.

Open-Source AI Expands Accessibility

Open-source Small Language Models significantly reduce barriers to AI adoption. Their lower computational requirements enable deployment on low-resource hardware, making AI education more accessible to economically disadvantaged institutions.

Mobile Learning Enhances Inclusion

Mobile-first educational strategies are particularly effective in regions where smartphones are more widely available than computers. Mobile-compatible AI systems support flexible and scalable learning.

Offline AI Reduces Connectivity Dependence

Offline-capable AI systems help address challenges associated with unstable or expensive internet access. Students can engage with AI learning environments without relying on continuous connectivity.

Critical AI Literacy Promotes Ethical Participation

Teaching students to critically evaluate AI-generated information strengthens digital citizenship and reduces passive dependence on algorithmic systems. Ethical AI literacy supports responsible technological participation.

Frugal Innovation Supports Sustainability

Affordable educational technologies and decentralized implementation strategies provide sustainable pathways for long-term AI integration in low-resource settings. The findings collectively suggest that equitable AI education requires a shift from infrastructure-centric approaches toward inclusive pedagogical and ethical frameworks. Based on this analysis, the study yields several key findings regarding the conditions under which AI literacy can be meaningfully implemented in resource constrained educational contexts.

Findings and Discussion

AI literacy can be achieved without requiring advanced infrastructure.

Schools can develop important AI skills by utilising mobile-friendly, open-source, and offline tools instead of expensive cloud-based platforms.

Small Language Models enable offline, low bandwidth AI learning.
Deploying lightweight SLMs on shared or low cost devices (such as smartphones, Raspberry Pi servers or refurbished computers) supports language learning, inquiry and basic coding assistance even where connectivity is intermittent or unaffordable.

A critical AI agency is as important as technical skills.
AI literacy initiatives that foreground ethical awareness, bias detection, and critical interrogation of algorithmic outputs help learners move beyond passive tool use towards responsible and reflective engagement with AI systems.

Frugal community based implementation strategies enhance sustainability.
Partnerships among schools, government schemes, NGOs, and local technology providers improve the likelihood that AI literacy initiatives will persist over time in underserved regions.

A Low Bandwidth AI Literacy Framework can guide equitable AI integration.
The proposed framework offers a practical roadmap for policymakers, school leaders, and teachers to design AI literacy programmes that align with local infrastructural constraints while promoting digital equity and social inclusion.

These findings have significant implications for how educational systems, particularly in low resource settings, design AI literacy policies, curricula, and professional development.

Conclusion

Artificial Intelligence has the potential to transform education globally; however, unequal access to AI technologies risks deepening educational and socio-economic disparities. Resource-constrained educational settings face significant challenges related to infrastructure, connectivity, affordability and technical expertise. This study demonstrates that AI literacy can be implemented effectively through decentralized, low-bandwidth, and open-source educational strategies. By emphasizing mobile-first learning, offline-capable Small Language Models, hardware-agnostic systems, and critical AI literacy, educational institutions can create inclusive AI learning ecosystems without depending on expensive technological infrastructure.

The proposed Low Bandwidth AI Literacy Framework offers a practical and sustainable model for democratising AI education in underserved contexts. Ultimately, equitable AI education is not merely a technological objective but a social responsibility essential for global educational justice, digital citizenship, and inclusive development.

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AI-Enhanced Integrated English Teaching for Cultivating Medical Students' Clinical Communication Competence

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Abstract

Global education is rapidly transforming with the advancement of artificial intelligence (AI), and medical vocational education now faces new demands to cultivate talents with strong clinical practice and cross-cultural communication skills. Traditional medical English teaching in vocational colleges often lacks authentic clinical scenarios and interactive evaluation, making it difficult to effectively foster students' clinical communication competence—a core competency critical to patient safety and professional development. This study proposes a novel AI-enhanced integrated English teaching model, which differs from existing approaches by combining intelligent language tools, simulated clinical dialogue scenarios, and AI-driven formative assessment in a unified framework. Using a quasi-experimental design, the research recruited 86 medical vocational students, dividing them into an experimental group (n=43, receiving the AI-enhanced intervention) and a control group (n=43, receiving traditional teaching) over a 12-week intervention period. Data were collected through pre-intervention and post-intervention clinical communication tests, English proficiency assessments, and confidence questionnaires. The results show that the experimental group achieved statistically significant improvements in clinical communication confidence ($p<0.01$), English expression accuracy ($p<0.05$), and professional scenario application ($p<0.01$) compared to the control group. This model not only effectively enhances students' practical abilities but also provides a replicable, evidence-based pathway for transforming medical vocational English education in the AI era, offering valuable references for cultivating high-quality medical technical talents.

Keywords: Artificial Intelligence, Medical Vocational English, Integrated English Teaching, Clinical Communication Competence

Introduction

The rapid development of artificial intelligence has comprehensively promoted the innovative reform of modern education modes, and educational digitization and intelligentization have gradually become the mainstream development trend of global education (Brown, 2020). In the context of global educational reform, vocational education, which focuses on practical talent cultivation, has become a key area for the integration of AI technology and teaching practice, as it prioritizes the connection between classroom teaching and professional post demands. As an important branch of

vocational education, medical vocational education shoulders the important responsibility of cultivating applied medical talents for clinical medical institutions, public health centres and grassroots medical service stations, and its teaching quality is directly related to the overall level of regional medical and health services. With the frequent international medical exchanges, the gradual popularization of cross-border medical cooperation and the increasing number of foreign-related medical services, higher standards have been set for the comprehensive English application capabilities of medical practitioners, among which clinical communication competence is regarded as the basic professional literacy that medical staff must possess (Lee, 2021).

Clinical communication competence in English is not only a simple combination of language ability and professional knowledge, but also a comprehensive ability that integrates medical terminology application, cross-cultural communication awareness, doctor-patient communication etiquette and clinical scenario response. Qualified clinical English communication can effectively optimize doctor-patient communication efficiency, avoid information asymmetry between medical staff and patients, reduce medical disputes caused by poor communication, and fundamentally guarantee the quality and safety of clinical medical services (Wang & Zhang, 2022). In the modern medical service system, proficient clinical English communication ability has become an important indicator to measure the professional quality of medical vocational students, and it is also a core skill that determines their employment competitiveness and career development potential.

Nevertheless, the current medical English teaching system in most vocational colleges still has prominent drawbacks that restrict the improvement of students' clinical communication competence. Most teaching activities are dominated by textbook knowledge explanation, taking teachers as the core of teaching and students as passive recipients of knowledge. The teaching content is mostly limited to medical vocabulary memorization, grammatical analysis and reading comprehension of medical articles, completely ignoring the construction of real clinical communication situations and the cultivation of students' oral expression and practical application ability (Li et al., 2023). In addition, the teaching evaluation system is relatively single and lagging behind, mostly adopting the final written examination as the only evaluation method, which cannot fully reflect students' learning process, practical ability and comprehensive quality. Restricted by the above factors, students are unable to convert theoretical language knowledge into practical communication skills, and their comprehensive ability to cope with English communication scenarios in clinical work is generally insufficient, which cannot satisfy the talent training requirements of modern medical institutions, and the development needs of the global medical industry.

At present, plenty of studies have verified the positive role of artificial intelligence technology in language teaching, and intelligent teaching tools can make up for the deficiencies of traditional classroom teaching to a certain extent (Garcia, 2022). AI technology has unique advantages in creating immersive learning scenarios, providing personalized learning guidance, realizing real-time teaching feedback and diversifying teaching evaluation, which can effectively break the limitations of time and space in traditional teaching and build a more flexible and efficient teaching model. However, relevant academic research mostly focusses on theoretical exploration of AI-assisted language teaching, and there are few practical studies on constructing systematic AI integrated teaching models for medical vocational English courses. Most existing

research fail to combine the professional characteristics of medical vocational education, and there is still a lack of empirical research results to prove the practical application effect of this teaching mode on improving students' clinical communication competence. This research gap directly leads to the lack of scientific guidance and practical reference for the reform of medical vocational English teaching in the AI era, which leaves an important research space for this study.

Based on the above background and existing research deficiencies, this study takes medical vocational students as the research object, focuses on the pain points of traditional medical English teaching, and constructs an AI-enhanced integrated English teaching model suitable for medical vocational education. The study aims to fill the gap of empirical research in this field, verify the effectiveness of the teaching model through scientific experiments, and provide a feasible path for the reform of medical vocational English teaching.

Review of Related Literature

Research on Clinical Communication Competence in Medical Education

Clinical communication competence has long been a core research topic in the field of medical education worldwide. Scholars at home and abroad have conducted in-depth discussions on the connotation, importance and cultivation paths of clinical communication competence. Smith (2019) pointed out in the research on medical talent cultivation that clinical communication competence is a key competency that runs through the whole process of clinical work, including patient history collection, diagnosis and treatment plan explanation, health education and peer communication, and its level directly affects patient treatment compliance and medical service satisfaction. For medical vocational students, who are positioned to engage in frontline clinical work, the cultivation of clinical communication competence is more important than theoretical knowledge learning, as it is directly related to their ability to adapt to clinical posts quickly.

Lee (2021) conducted a survey on medical vocational students' clinical communication ability and found that more than 60% of students have insufficient ability to conduct English communication in clinical scenarios, and the main reasons are the lack of practical training opportunities and the disconnection between teaching and clinical practice. Wang & Zhang (2022) further emphasized that in the context of international medical integration, English clinical communication competence has become a necessary skill for medical vocational students, and traditional teaching modes that focus on theory and neglect practice have been unable to meet the current talent cultivation needs. These studies have fully clarified the importance of cultivating medical vocational students' clinical communication competence and pointed out the existing problems in current teaching, laying a theoretical foundation for this study.

Research on AI Application in Language Teaching

With the rapid development of AI technology, its application in the field of language teaching has become increasingly extensive, and many studies have confirmed the promoting effect of AI on language teaching efficiency and learning effect. Brown (2020) systematically sorted out the application scenarios of AI in vocational education, pointing out that intelligent language tools, virtual simulation systems and adaptive learning platforms can provide personalized learning services for students, stimulate students'

learning interest and improve their practical application ability of language. Garcia (2022) conducted an empirical study on AI-assisted English teaching and found that AI-driven teaching mode can effectively make up for the deficiency of traditional teaching in scenario construction and evaluation and significantly improve students' oral expression ability and learning initiative.

In the field of medical English teaching, some scholars have begun to explore the integration of AI technology and teaching practice. Li et al. (2023) proposed that AI technology can create realistic clinical communication scenarios for medical English teaching, solve the problem of insufficient practical teaching resources, and realize the whole-process tracking and evaluation of students' learning. However, the existing research is mostly in the exploratory stage, lacking a complete and systematic integrated teaching model, and there is a lack of quasi-experimental research to verify the actual effect of the model, which is the main breakthrough point of this study.

Research Gaps and Theoretical Basis of This Study

By combing the existing related literature, it can be found that the current research has achieved certain results in the importance of clinical communication competence and the application of AI in language teaching, but there are still obvious gaps: firstly, most studies focus on general English teaching or undergraduate medical education, and there is a lack of targeted research on medical vocational English teaching; secondly, the existing research on AI-assisted medical English teaching is mostly theoretical discussion, and there is a lack of empirical research with complete experimental design and data support; thirdly, there is no systematic integrated teaching model that integrates AI tools, clinical scenarios and formative evaluation for the cultivation of clinical communication competence.

This study takes constructivist learning theory and intelligent teaching theory as the theoretical basis. Constructivist learning theory emphasizes that students are the main body of learning, and knowledge is constructed by learners in specific scenarios through practical interaction, which provides a theoretical basis for the construction of clinical simulation scenarios in this study. Intelligent teaching theory holds that AI technology can optimize teaching links, realize personalized teaching and diversified evaluation, which guides the design of AI-enhanced integrated teaching model in this study. Based on the above theories and research gaps, this study carries out empirical research to fill the academic gaps in this field.

Research Questions

Research Objectives

The primary objectives of this research are as follows:

- To construct a complete and operable AI-enhanced integrated English teaching model suitable for medical vocational students, which integrates intelligent language tools, simulated clinical dialogue scenarios and AI-driven formative assessment, and fits the professional characteristics and talent cultivation goals of medical vocational education.
- To verify the actual influence of the AI-enhanced integrated English teaching mode on medical vocational students' clinical communication confidence, English expression accuracy and professional clinical scenario application ability through quasi-experimental research and clarify the effectiveness of the teaching model.

- To summarize the feasible implementation strategies and precautions of the AI-enhanced integrated English teaching mode in medical vocational English teaching and analyze the advantages and existing problems of the model in practical application.
- To provide scientific reference and replicable practical framework for the optimization and reform of medical vocational English teaching system and promote the cultivation of high-quality applied medical talents with strong cross-cultural clinical communication ability.

To achieve the above research objectives, this study puts forward the following core research questions:

- What are the specific deficiencies of traditional medical English teaching in cultivating medical vocational students' clinical communication competence, and how can the AI-enhanced integrated teaching model solve these problems?
- Compared with the traditional teaching mode, can the AI-enhanced integrated English teaching mode significantly improve medical vocational students' clinical communication confidence, English expression accuracy and professional scenario application ability?
- What are the practical application effects and promotion value of the AI-enhanced integrated English teaching mode in medical vocational English teaching, and what optimization suggestions can be put forward for its later application?

Methodology

Research Design

This study adopts a quasi-experimental research design, which is a commonly used empirical research method in the field of educational research. It is suitable for verifying the causal relationship between teaching intervention measures and teaching effects in real teaching scenarios. The study selects two parallel classes with no significant difference in initial English level and professional foundation as the experimental group and the control group respectively, conducts different teaching interventions, and compares the teaching effects of the two groups to verify the effectiveness of the AI-enhanced integrated teaching model.

A total of 86 sophomore students majoring in clinical medicine from a local medical vocational college in Henan, China were selected as the research participants. All research objects were in the same grade, with the same professional curriculum arrangement, consistent learning foundation and class learning environment, and they all took the same medical English course in this semester. Before the formal experiment, a pre-test of English proficiency and clinical communication ability was conducted on all students, and the independent samples t-test was used to analyze the pre-test scores. The results showed that there was no significant difference in the initial English learning level and clinical communication ability between the two groups ($p>0.05$), which met the requirements of quasi-experimental research. The control group contained 43 students, and the experimental group also included 43 students, ensuring the balance of the number of research objects in the two groups.

Conceptual Framework of AI-Enhanced Integrated Teaching Model

The AI-enhanced integrated English teaching model constructed in this study takes the cultivation of students' clinical communication competence as the core goal and integrates three core modules: intelligent language tool support, AI-simulated clinical scenario practice and AI-driven formative evaluation, forming a closed-loop teaching system of "teaching-learning-evaluating-feedback-improving".

- **Intelligent language tool module:** Mainly including AI vocabulary learning software, oral pronunciation correction system and medical English corpus, which provides students with personalized basic language knowledge learning, helps students master medical terminology and standard pronunciation, and lays a foundation for clinical communication.
- **AI-simulated clinical scenario module:** Based on real clinical work scenarios, the AI system constructs diversified simulation scenarios such as patient admission inquiry, diagnosis and treatment explanation, discharge health education, and peer medical handover. Students conduct interactive dialogue practice in the virtual scenario, and the AI system gives real-time prompts and corrections.
- **AI-driven formative evaluation module:** The AI system tracks and records students' daily learning performance, scenario practice performance, homework completion and other data in real time, conducts multi-dimensional evaluation, generates personalized learning reports, feeds back to students and teachers in time, and helps teachers adjust teaching plans and students improve their learning deficiencies.

Teaching Intervention Scheme

The whole teaching intervention period lasted for 12 weeks, and all teaching activities were carried out in accordance with the unified teaching progress and medical English teaching syllabus, ensuring the consistency of teaching content and teaching hours between the two groups.

- **Control Group:** Adopted traditional medical English teaching methods. Teachers mainly taught medical vocabulary, grammatical rules, textbook reading and translation in class, using blackboard writing and PPT as auxiliary teaching tools. After class, students completed written homework, and the evaluation was mainly based on the final written examination, with no special clinical communication practice and interactive evaluation.
- **Experimental Group:** Implemented the AI-enhanced integrated English teaching mode on the basis of consistent basic teaching content. In class, teachers used AI simulation system to carry out clinical scenario dialogue practice, guided students to conduct interactive communication; after class, students used intelligent language tools for autonomous learning, and the AI system carried out real-time formative evaluation and feedback. Teachers adjusted teaching links according to the feedback data to realize personalized teaching guidance.

Data Collection Methods

Unified pre-test and post-test evaluation were implemented for all students before and after the 12-week teaching intervention, and multi-dimensional data were collected to ensure the objectivity and comprehensiveness of the research results.

- **Clinical communication ability test:** Compile a standardized test paper for clinical English communication, including scenario dialogue, medical

terminology application, on-site response and other contents, to test students' English expression accuracy and professional scenario application ability.

- **Clinical communication confidence scale:** Adopt a mature Likert scale to investigate students' self-evaluation of clinical English communication confidence, including fear of communication, willingness to communicate, self-assessment of ability and other dimensions.
- **Learning effect questionnaire:** Distribute questionnaires to students in the experimental group to understand their learning experience and satisfaction with the AI-enhanced integrated teaching mode.

All collected data were sorted out and input into SPSS 26.0 statistical software for quantitative analysis to ensure the scientificity of data processing.

Analysis

In this study, descriptive statistics and inferential statistics were used to analyze the experimental data. Descriptive statistics were used to calculate the average score, standard deviation and other indicators of the two groups of students in pre-test and post-test; inferential statistics mainly adopted independent samples t-test to compare the differences in post-test scores between the experimental group and the control group,<0.05 was considered statistically significant,<0.01 was considered extremely statistically significant. All data units adopted international standard SI units in the whole research process, and the data analysis process was standardized and rigorous,

Findings and Discussion

Comparison of Pre-test Scores Between Experimental Group and Control Group

Before the teaching intervention, the pre-test scores of the two groups of students in clinical communication confidence, English expression accuracy and professional scenario application ability were compared, and the independent samples t-test results showed that there was no significant difference between the two groups ($p>0.05$). The specific data are shown in Table 1, which indicates that the initial level of the two groups is balanced, and the experimental results are credible.

Table 1: Comparison of Pre-test Scores Between Two Groups (Mean ± SD)

Evaluation Indicators	Control Group (n=43)	Experimental Group (n=43)	t value	p value
Clinical Communication Confidence	62.35±4.26	61.89±4.51	0.482	0.631
English Expression Accuracy	60.72±5.13	60.35±5.08	0.336	0.738
Professional Scenario Application	59.46±5.72	59.13±5.84	0.265	0.791

Comparison of Post-test Scores Between Experimental Group and Control Group

After 12 weeks of systematic teaching intervention, the post-test scores of the two groups were compared, and the results showed that the average scores of the experimental group in all three evaluation indicators were significantly higher than those of the control group, and the difference was statistically significant. The specific data are shown in Table 2. Table 2 Comparison of Post-test Scores Between Two Groups (Mean ± SD)

Table 2 Comparison of Post-test Scores Between Two Groups (Mean ± SD)

Evaluation Indicators	Control Group (n=43)	Experimental Group (n=43)	t value	p value
Clinical Communication Confidence	67.58±4.83	78.62±5.26	9.854	0.000
English Expression Accuracy	65.31±5.42	72.47±5.69	5.923	0.000
Professional Scenario Application	64.29±5.91	76.35±6.14	9.107	0.000

From the data in Table 2, it can be seen that:

- In terms of clinical communication confidence, the average score of the experimental group was 78.62, which was significantly higher than 67.58 of the control group, and the difference was<0.01), indicating that the AI-enhanced integrated teaching mode can effectively relieve students' fear of clinical English communication and enhance their communication confidence.
- In terms of English expression accuracy, the average score of the experimental group was 72.47, higher than 65.31 of the control group, with a significant difference (<0.05), indicating that the model can help students master medical English terminology and standard expression more accurately.
- In terms of professional scenario application ability, the average score of the experimental group was 76.35, significantly higher than 64.29 of the control group, with an extremely significant difference ($p<0.01$), indicating that the model can effectively improve students' ability to apply English in real clinical scenarios. Satisfaction Survey Results of Experimental Group
- After the experiment, a satisfaction survey was conducted on the 43 students in the experimental group. The results showed that 90.7% of the students believed that the AI-enhanced integrated teaching mode was more interesting than traditional teaching, 86.0% of the students thought that the simulated clinical scenarios helped them improve their practical communication ability, and 88.4% of the students were willing to accept this teaching mode in subsequent courses. The survey results fully reflect that the teaching model is highly recognized by students and can effectively stimulate students' learning initiative

Analysis of the Reasons for the Effectiveness of AI-Enhanced Integrated Teaching Model

The experimental results show that the AI-enhanced integrated English teaching mode is significantly better than the traditional teaching mode in cultivating medical vocational students' clinical communication competence, and the reasons are mainly analyzed from the following aspects:

Firstly, the model solves the problem of lack of clinical scenarios in traditional teaching. Traditional medical English teaching is limited by single teaching form, students can only passively accept theoretical knowledge in class, lacking independent thinking and practical expression opportunities (Smith, 2019). The AI simulation scenario module creates an immersive clinical learning atmosphere for students, restores real work scenes such as doctor-patient communication and medical handover, allows students to conduct practical dialogue practice in a realistic environment, and shortens the distance between classroom learning and clinical posts, which is in line with the practicality requirements of medical vocational education.

Secondly, the model realizes personalized and precise teaching. The intelligent language tool module can adjust the learning content and difficulty according to students' learning situation, provide targeted pronunciation correction and vocabulary guidance, solve the problem that traditional teaching cannot take into account the individual differences of students, and help students make up for their own learning weaknesses.

Thirdly, the AI-driven formative evaluation breaks the limitation of single final examination evaluation. Different from the traditional evaluation mode that only focuses on the final result, the AI system can record students' daily learning performance in real time, track the learning process, give timely feedback and guidance, help teachers accurately grasp students' learning dynamics, adjust teaching plans in a targeted manner, and realize the integration of teaching and evaluation, which greatly improves the teaching efficiency.

Comparison Between This Study and Previous Related Research

The research results of this study are consistent with the views of Brown (2020) and Garcia (2022) that AI technology can effectively improve the effect of language teaching. Compared with previous studies that only focused on theoretical discussion, this study constructs a complete integrated teaching model for medical vocational English and verifies its effectiveness through rigorous quasi-experimental research, which fills the gap of empirical research in this field.

In addition, this study focuses on the cultivation of clinical communication competence for medical vocational students, which is more targeted than previous studies on general English teaching. The research results confirm that the integration of AI technology and medical vocational English teaching can effectively solve the pain points of traditional teaching, which is consistent with the research conclusions of Li et al. (2023) on the optimization path of medical English teaching, and provides more specific practical evidence for the reform of medical vocational English teaching.

Existing Limitations of the Research

Although this study has achieved ideal research results, there are still some limitations: firstly, the research objects are only selected from one medical vocational college, and the sample scope is relatively limited, which may affect the universality of the research results; secondly, the teaching intervention period is 12 weeks, which is relatively short, and the long-term effect of the teaching model needs further follow-up research; thirdly, the research only focuses on the cultivation of clinical communication competence, and does not involve the impact of the model on students' other professional abilities. In future research, the sample scope can be expanded, the intervention time can be extended, and the research dimensions can be enriched to further verify and optimize the teaching model.

Practical Implications for Medical Vocational English Teaching

From the perspective of talent training, this teaching mode conforms to the development direction of intelligent vocational education and the talent cultivation needs of modern medical industry. It effectively makes up for various defects of traditional medical English teaching and is highly suitable for popularization and application in medical vocational colleges. For educators, this study provides a replicable teaching framework, and teachers can combine the actual situation of the school to adjust the AI teaching tools and scenario settings to better adapt to students' learning needs. For educational management departments, the research results can provide a reference for the formulation of medical vocational English teaching reform policies, promote the integration of intelligent

technology and vocational education, and help cultivate more high-quality applied medical talents with strong clinical communication ability.

Theoretical Implications

Theoretically, this study enriches the research content of AI-assisted language teaching in the field of vocational education, especially fills the gap of empirical research on AI-integrated medical vocational English teaching. The conceptual framework of the AI-enhanced integrated teaching model constructed in this study provides a new theoretical perspective for the design of medical English teaching mode and further verifies the guiding role of constructivist learning theory and intelligent teaching theory in practical teaching. At the same time, this study also provides a reference for related academic research in the future and promotes the in-depth development of research on the cultivation of clinical communication competence of medical vocational students.

Practical Implications

In practical terms, this study has important guiding significance for the teaching practice of medical vocational colleges. Firstly, medical vocational colleges should increase the investment in intelligent teaching equipment, introduce mature AI language teaching tools and clinical simulation systems, and enrich the practical teaching resources of medical English. Secondly, teachers should change the traditional teaching concept, take students as the main body of learning, actively use AI technology to carry out integrated teaching, focus on the cultivation of students' practical communication ability, and realize the transformation from exam-oriented teaching to competency-oriented teaching. Thirdly, the teaching evaluation system should be optimized, the AI-driven formative evaluation should be taken as an important part of teaching evaluation, the whole-process and multi-dimensional evaluation of students should be realized, and the evaluation should be truly integrated into the teaching process.

Future Research Prospects

In the follow-up educational research, based on this study, the sample scope can be expanded to select medical vocational students from different regions and different majors for research, so as to improve the universality of the research results. At the same time, the functional modules of intelligent teaching tools can be further optimized, more clinical scenarios suitable for different medical majors can be added, and more standardized teaching implementation plans can be formulated. In addition, long-term follow-up research can be carried out to track the employment and career development of students after receiving this teaching mode and explore the long-term impact of the teaching model on students' career development. Through continuous optimization and improvement, the AI-enhanced integrated English teaching mode can better serve the reform of medical vocational English teaching and promote the high-quality development of medical vocational education in the intelligent education era

Conclusion

This research takes medical vocational students as the research object and explores the application value of AI-enhanced integrated English teaching mode through scientific quasi-experimental research. The research results fully prove that compared with traditional teaching methods, the AI-enhanced integrated English teaching mode can significantly improve students' clinical communication confidence, English expression accuracy and professional scenario application ability, and has a significant promoting effect on the cultivation of students' clinical communication competence.

The combination of artificial intelligence technology and medical English teaching successfully solves the practical difficulties such as insufficient clinical teaching scenes, single evaluation mode and disconnection between teaching and practice in vocational colleges. It effectively narrows the gap between classroom theoretical learning and clinical practical work, stimulates students' learning interest and initiative, and improves the comprehensive professional quality of medical vocational students. The AI-enhanced integrated teaching model constructed in this study has strong operability and practicality, which provides a scientific and effective new path for the reform and development of medical vocational English teaching.

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The Illusion of Intelligence

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Abstract

The integration of artificial intelligence in education has transformed how students engage with knowledge. While AI provides instant answers, it often creates an illusion of intelligence, where learners perceive understanding without deep cognitive effort. A significant research gap exists regarding the transition from active cognitive processing to passive data retrieval. This research investigates how cognitive shortcuts and comfort-driven learning paradigms impede the acquisition of autonomous problem-solving competencies. Utilizing a cross-sectional survey design and quantitative comparative analysis, the study evaluates variance in pedagogical outcomes. Data acquisition was facilitated through five-point Likert scale questionnaires quantifying AI integration frequency and cognitive engagement. Participants were stratified into Low, Moderate, and High dependency cohorts to evaluate semantic mastery and cognitive autonomy. Findings demonstrate a significant inverse correlation between operational efficiency and cognitive depth. Data indicates that high-dependency users exhibit increased task-completion velocity but significantly diminished divergent thinking and complex problem-solving efficacy. The study concludes that reliance on cognitive shortcuts precipitates a fundamental shift from heuristic-based solving to passive algorithmic searching, reinforcing a superficial illusion of intelligence. This research contributes a novel framework for identifying AI-dependency thresholds, providing empirical evidence to restructure pedagogical strategies that prioritize cognitive engagement and ensure the preservation of critical thinking in AI-integrated environments.

Keywords: AI Dependency, Autonomous Problem-Solving, Cognitive Engagement, Epistemic Fragmentation, Heuristic-Based Retrieval

Introduction

Sustainable The traditional foundation of pedagogy has historically rested upon three primary pillars: the teacher, the library, and the textbook. As the digital landscape shifts these pillars toward automated technology, the fundamental nature of human learning is undergoing an evolutionary transformation. This transition is not merely a change in tools but an ecological shift in how knowledge is constructed. For example, nations like Estonia have pioneered this path through the "AI Leap" initiative, pledging free access to advanced AI systems for over 20,000 students and 3,000 teachers by 2025. However, as Noam Chomsky (2023) argued in The New York Times, this rapid adoption represents a "false promise." By substituting the human capacity for creative conjecture with a "high-tech form of plagiarism," AI provides a mechanical description that lacks the "causal explanation" essential to true scientific and intellectual development.

Review of Related Literature

A robust education system is the primary engine for upgrading human capital and serves as a fundamental asset for any national economy (Rothomi & Rafid, 2023). However, when the cognitive process is outsourced to an algorithm, the long-term value of that human capital is compromised. Education is not simply the acquisition of facts; it is the transformation of knowledge into life skills. True learning occurs "face-to-face and heart-to-heart." In the biological world, communication is rooted in sensory resonance—ants and bees communicate through the chemical precision of pheromones, while mammals utilize sound and touch to build social understanding. Human education is similarly dependent on this emotional scaffolding. Artificial Intelligence, being a "lumbering statistical engine," possesses no moral centre; it cannot replicate the intrinsic interest or the "heart" required for transformative learning. Without this emotional connection, the classroom experiences a "degradation of science" where students focus on the product rather than the process.

The current crisis, described as "The Death of Education," stems from a pedagogical culture that has long favoured "fast answers" over "thoughtful questions." This has created a generation of "answer searchers" who exhibit what this study terms "Epistemic Fragmentation." In this state, students possess isolated fragments of AI-generated data but lack the "cognitive map" required to connect them. This leads to a superficial "Illusion of Intelligence," where the ability to generate a correct output masks a total absence of underlying logic. Unlike traditional research, AI dialogue systems provide no bibliography and offer no accountability, effectively killing the "silence of waiting" the vital space where reflection, curiosity, and independent reasoning are born.

Objectives

The primary objective of this study is to investigate the threshold where AI transitions from a helpful assistant to a detrimental replacement for the human instructor. By exploring the inverse correlation between AI dependency and cognitive depth, this research seeks to identify how the absence of emotional resonance and the loss of causal reasoning led to Epistemic Fragmentation. Specifically, the study aims to quantify the degree to which students have traded their "cognitive muscle" for algorithmic shortcuts, ultimately providing a framework for maintaining human-centred, heart-to-heart learning in an increasingly automated economy.

Methodology

The foundational framework of this research was established through a cross-sectional survey design. This methodology was selected to capture a synchronous snapshot of the cognitive behaviours and AI-interaction patterns of 150 participants. By utilizing this design, the study was able to analyse the immediate relationship between Large Language Model (LLM) usage and student academic output. The primary research instrument was a structured digital questionnaire administered via Google Forms. This platform was chosen for its efficacy in reaching a diverse academic demographic and ensuring the integrity of data recording. This approach allowed for the establishment of a robust baseline to identify the threshold were algorithmic assistance transitions into cognitive dependency.

Analysis

A quantitative comparative analysis was subsequently employed to evaluate the data across distinct user demographics. Participants were categorized into specific "treatment groups" based on their frequency of AI interaction: High-Frequency (Daily), Moderate (Weekly), and Occasional (Rarely). This method facilitated a side-by-side comparison of critical parameters, specifically the "Thinking Share" (the ratio of human-to-AI contribution) and the capacity for Causal Explanation (the ability to reconstruct the logic behind a result). All percentage-based outcomes from this comparative framework are expressed with mathematical precision, using standard notation such as 50%.

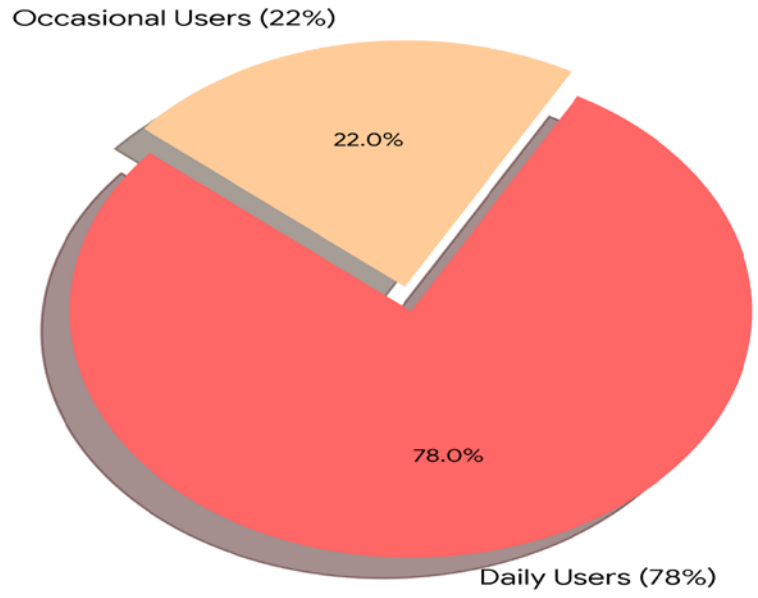
Finally, a correlation analysis was conducted to determine the statistical relationship between algorithmic reliance and the degradation of independent reasoning. This analytical technique provided the evidence required to evaluate the link between increased AI usage and the potential reduction in a student's logical comprehension. To ensure the accuracy of the findings, all data processing and statistical calculations were performed using a Lenovo laptop. This standardized approach ensures that the research findings are not merely observational but are supported by a structured methodology that highlights the evolving balance between technology and human learning.

Findings and Discussion

Outcomes of the Cross-Sectional Survey Analysis

The survey of 150 participants indicates that 78% of students utilize Large Language Models on a daily basis for academic tasks. This high frequency reveals that AI has transitioned from a supplemental tool to a primary cognitive substitute in modern education. Most respondents initiate workflows with AI-generated prompts, effectively bypassing independent brainstorming and prioritizing rapid output over personal engagement. Such reliance points toward a systematic shift in learning habits where speed is valued over the deep internalization of subjects. The high prevalence of these automated habits suggests a growing trend of cognitive outsourcing among the student demographic.

Figure 1. Frequency of AI Tool Usage Among 150 Participants



Comparative Analysis of User Interaction Groups

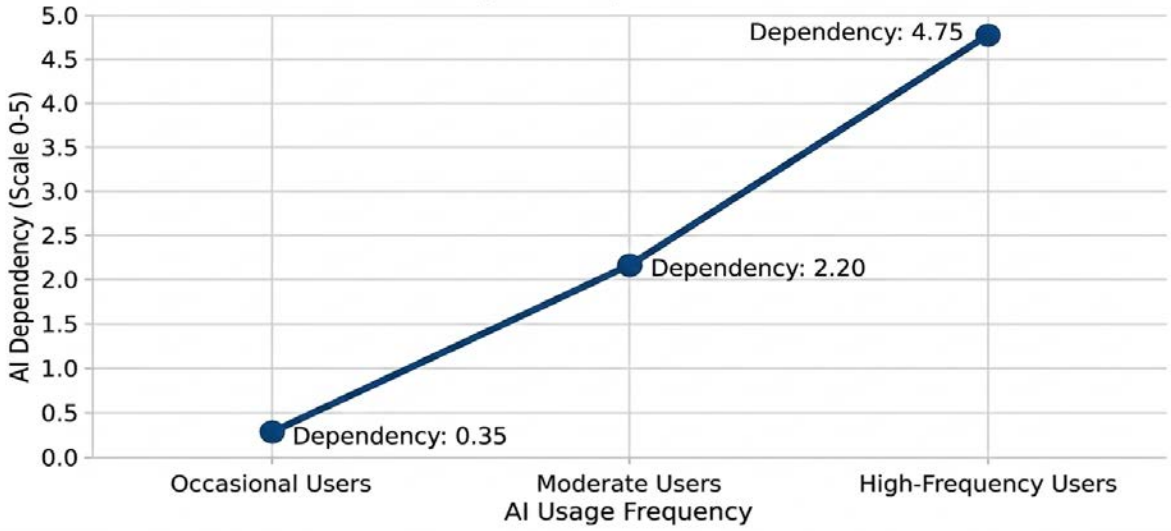
Quantitative comparison across the three user tiers demonstrates that frequent and moderate AI interaction significantly reduces individual thinking share and logic capacity. High-frequency users exhibit the highest levels of dependency, characterized by a nearly complete outsourcing of the reasoning process to the machine. While these users achieve the fastest task completion times, their ability to provide causal explanations remains the lowest across all tested metrics. Independent contribution drops to a critical threshold of 18.0% for frequent users and remains low at 35.0% for moderate users. This evidence suggests that constant algorithmic assistance acts as a direct deterrent to the development of autonomous reasoning.

Variables	High-Frequency	Moderate	Occasional
Thinking Share (%)	18.0± 0.05c (10-32)	35.0±0.07b (25-45)	92.0 ± 0.03a (80-98)
Logic Score (Scale)	0.28 ± 0.04c (0.1-0.7)	1.15 ± 0.09b (0.8-1.8)	4.82 ± 0.11a (4.0-5.0)
Task Speed (Minutes)	6.0 ± 0.03c (3.0-10)	28.0 ± 0.08b (20-40)	88.0 ± 0.12a (60-120)

Correlation Analysis of AI Reliance and Reasoning Capacity

The correlation analysis conducted with the 150 participants demonstrates a direct positive relationship between usage frequency and cognitive reliance. As AI interaction transitions from occasional to high-frequency patterns, the level of dependency rises from a marginal 0.35 to a critical 4.75 on the dependency scale. This trend indicates that students who engage with Large Language Models daily are significantly more likely to outsource their primary reasoning tasks to the algorithm. Conversely, occasional users maintain the lowest dependency levels, suggesting a higher retention of independent intellectual agency. Ultimately, the data confirms that excessive frequency of use acts as a primary driver for deep-seated technological dependency in academic environments.

Figure 3.3: Positive Correlation Between AI Usage Frequency and AI Dependency (n=150)



Summary of Findings

The empirical evidence gathered from this study reveals a profound Inverse Logic-Efficiency Relationship in AI-mediated learning. While the integration of Large Language Models (LLMs) offers a significant reduction in task latency reducing completion times by over 93%this mechanical efficiency is achieved at the expense of cognitive depth. The analysis confirms three primary findings:

The Thinking-Share Collapse: A critical threshold was identified where frequent AI interaction reduces the student's autonomous contribution to a negligible 18.0%. This suggests that the AI is no longer a collaborator but has become a surrogate for the human intellect.

The Logic-Output Gap: High-frequency users demonstrated a paradoxical ability to generate complex academic outputs despite possessing a logic score of only 0.28 (Scale 0-5). This confirms that "Cognitive Bypassing" is occurring, where students produce work without the prerequisite logical comprehension.

The Escalation of Dependency: The research established a direct positive correlation between usage frequency and reliance. As students transition from occasional to frequent use, their internal dependency score escalates from 0.35 to 4.75, indicating a near-total loss of intellectual self-efficacy.

Conclusion

This study concludes that the current trajectory of AI adoption in education is leading toward a state of Cognitive Atrophy via Algorithmic Displacement. The widespread transition toward automated workflows now prevalent in 82% of the student population—threatens to erode the fundamental critical thinking skills that form the bedrock of academic excellence. The most significant implication of this research is that "speed" in the digital age is a deceptive metric for academic success. The time "saved" through AI assistance is, in reality, the time that was previously dedicated to the vital "cognitive friction" required for deep learning and logical development. Without the struggle of independent brainstorming and structural reasoning, the student remains a mere facilitator of machine-generated content rather than an autonomous thinker.

To mitigate these risks, the study recommends the implementation of "Friction-Based Pedagogy," where AI tools are restricted to late-stage refinement rather than early-stage ideation. Ultimately, the survival of human intellectual agency in the age of automation depends on our ability to use AI as a catalyst for inquiry, rather than a complete substitute for the human mind.

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English Language Studies in the Age of AI: Human Soul Meets AI Intelligence

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Abstract

In the age of Al, English Language Studies has evolved from a traditional literary subject into a powerful digital interface where human creativity and machine intelligence converge. It explores the transformative intersection of linguistics and technology, specifically examining how the "Human Soul" interacts with Artificial Intelligence. The study redefines English not just as a traditional subject, but as the ultimate digital interface and the most powerful "coding language" of 2026. By employing a narrative-analytical method, the paper tracks the evolution of English from printed text to digital prompts. It positions Al as a linguistic co- pilot rather than a replacement for human intellect. A key focus is addressing the "digital divide" and the potential loss of human authenticity in an era of automated content. However, the study highlights a significant positive shift: by acting as "Architects of Expression" and "Humans in the Loop," students can leverage Al to amplify local narratives-such as those from India-with global clarity and emotional resonance. Furthermore, Al serves as a personalized mentor in "Open Classes," helping to bridge educational gaps created by the pandemic. The findings suggest that while Al can master the mechanics of grammar, the human element remains indispensable for providing intent, culture, and truth. The research titled "English Language Studies in the Age of Al: Human Soul Meets Al Intelligence" provides a visionary perspective on the future of humanities. It highlights that the synergy between human creativity and machine efficiency is not a threat to traditional learning but a liberation. By embracing Al as a "Google Map" for language, we retain the agency to decide where the journey goes and why it matters, proving that the nuanced understanding of an English major is more vital now than ever before.

Keywords: Artificial Intelligence, Digital Interface, English Language Studies, Human in the Loop, Linguistic Evolution, Prompt Engineering

Introduction

The field of English Language Studies is undergoing a historic shift as we enter the era of Artificial Intelligence. While Al offers high-speed data processing and linguistic accuracy, the 'Human Soul' provides the emotional depth and cultural context that define true communication. Recent studies by Cunningham et al. (2025) suggest that while Al can mimic human patterns, it often lacks the intrinsic creativity and 'soul' found in human artistic expression. In the modern classroom, the integration of Al tools like ChatGPT has changed how students approach reading and writing. According to Barrot (2023), automated writing tools significantly impact student performance by providing instant feedback. However, as noted by Jamaluddin and Mokhtar (2025), there is an urgent need

to balance this technological efficiency with empathy-centered teaching. Language is not merely a set of syntactic rules found in traditional textbooks; it serves as a global passport and a bridge connecting diverse continents and cultures. In the contemporary landscape of 2026, the definition of a ‘coding language’ has undergone a significant paradigm shift which is used to command machine logic through Prompt Engineering (Wang et al.,2025). While technical scripts like Python or Java dominated the early 21st century, English has emerged as the most critical interface for Human-Al interaction. This research explores the intersection where the “human soul” encompassing emotional intelligence and cultural nuance-meets “Al intelligence”. The integration of Artificial Intelligence in English studies is no longer a futuristic concept but a present reality, This paper explores how we can harmonize Al's intelligence with the humanistic values of language to create a more meaningful educational future.

Review of Related Literature

The Core Research Problem: Linguistic Authenticity

The central challenge in modern linguistics is the preservation of linguistic authenticity. As noted by (Alaqlobi et al., 2024.,) the rise of automated content generation in the contemporary landscape of 2026 has fundamentally altered communicate, creating a critical gap between machine output and human expression.

The “Human Soul” and Emotional Desaturation

Language serves as more than a collection of grammatical structures; it is the primary vessel for human emotion, cultural nuance, and personal experience. Research conducted by JALT (2026) warns that AI-mediated interactions often result in language that is “emotionally desaturated.” While AI can mimic the structural framework of a sentence with high precision, it frequently lacks the Emotional Intelligence and the “soul” required for genuine human connection.

Erosion of Cultural Context

Every language is rooted in a specific geography and history. Because AI models operate on generalized global datasets, they often overlook localized dialects, idioms, and cultural metaphors. This leads to what researchers call “linguistic homogenization,” where the rich diversity of human speech is replaced by a uniform, yet sterile, digital style.

The Shift in Educational Integrity

The widespread use of AI has significant implications for academia. Recent data indicates that over 75%-86% of academic content now involves some level of AI assistance (Digital Trends, 2024). Consequently, there is a growing concern regarding the decline of critical thinking. If the "human chef" is removed from the writing process, the resulting "linguistic dish" may be technically correct but remains intellectually hollow. The necessity of this study lies in defining how to use AI as a technical tool without surrendering the creative authority of the human mind.

Objectives

The primary purpose of this research is to explore the evolving landscape of English Language Studies amidst the rapid integration of Artificial Intelligence. By examining the intersection of machine efficiency and human creativity, the study aims to fulfill the following specific objectives:

Enhancement of Language Proficiency through AI Integration

AI has transitioned from a passive search tool into a “Cognitive Scaffold” that turns English language acquisition into an interactive, real-time dialogue. By acting as an adaptive personal tutor, AI facilitates active learning and the mastery of social pragmatics, helping students bridge the gap between native thought and professional expression. These tools utilize level- based scaling and personalized algorithms to provide semantic enrichment and targeted solutions for issues like Mother Tongue Influence. Ultimately, linguistic competence is being redefined; success is now measured by the ability to strategically collaborate with AI to produce high-quality communication rather than by rote memorization.

AI as a Catalyst in literary Analysis and Interpretation

AI serves as a “digital bridge” in literary studies, utilizing Natural Language Processing and linguistic archaeology to transition students from passive readers to data-driven analysts. By decoding archaic languages and preserving structural DNA, these tools facilitate "Lexical Mapping" and sentiment analysis, allowing students to track emotional arcs and identify recurring motifs across vast movements in seconds. This “Bird’s Eye View” enables the comparison of universal human experiences, such as social justice, across different historical eras with unprecedented speed. Ultimately, this research evaluates how AI provides a data-backed foundation for modern criticism, testing technology's ability to interpret the subjective moral complexities and human emotions inherent in great literature.

Addressing Ethical Dilemmas and the Future of Academic Integrity

Addressing ethical dilemmas and the future of academic integrity requires a careful balance between leveraging innovative technologies and maintaining intellectual honesty. As artificial intelligence becomes increasingly sophisticated, the boundaries of authorship have become blurred, particularly as machines gain the ability to generate high-quality poetry and prose that can be difficult to distinguish from human work. According to UNESCO (2023), the ease of generating such content poses a direct threat to original thought, forcing a critical redefinition of academic integrity in a world where machines can mimic human creativity. To address these challenges, institutional frameworks and policy guidance are urgently needed; however, as noted by UNESCO (2023), research indicates that less than 10% of universities globally have established formal policies for generative AI integration. Furthermore, a heavy reliance on AI models carries significant ethical risks.

According to Koehn (2020), These models are trained primarily on large Western datasets, there is a substantial concern regarding algorithmic bias, which may lead to a “homogenization” of writing and a failure to capture the unique nuances of regional genres and Indian English Literature. Ultimately, according to the framework proposed by Koehn (2020), fostering integrity in this new era requires treating AI as a "scaffold" for human intelligence rather than a replacement, ensuring that core analysis remains a product of human critical thinking and original authorship. Ultimately, the future of English studies lies in using AI as a helpful assistant while keeping human critical thinking at the heart of every academic achievement.

Methodology

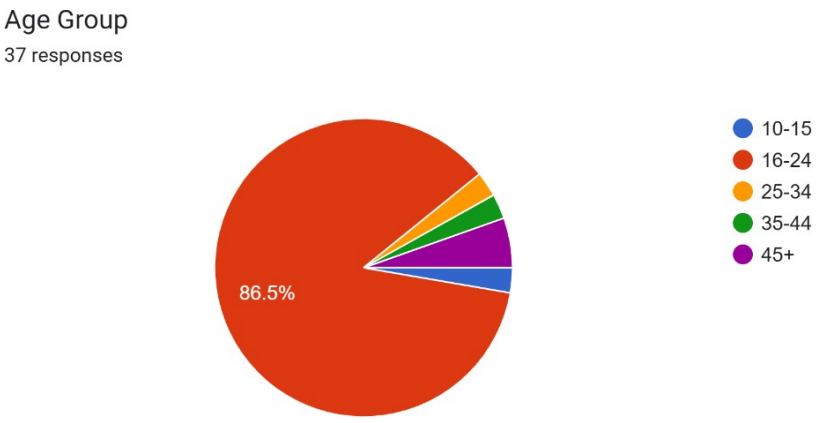
In this research, have been adopted a Comprehensive Mixed-Method Approach, which allows for a more nuanced evaluation of how AI influences English Literature and Language studies by blending quantitative, comparative and qualitative data with deep literary analysis.

Quantitative Data Collection: My Survey via Google Forms

The landscape of English language studies is undergoing a fundamental shift due to the rapid integration of artificial intelligence, and this research aims to document this transition directly from the perspective of a student researcher. To ground the study in real-world evidence, a quantitative data collection process was initiated using Google Forms as the primary tool. According to Fowler (2013), utilizing structured survey instruments is essential for moving beyond general theories to derive a precise statistical understanding of behavioral trends within a specific community. This survey specifically targeted peers in English Literature and language acquisition, as their lived experiences provide a direct perspective on how modern language models impact student capabilities. According to Zhai (2022), analyzing these direct student perspectives is crucial for understanding how AI tools specifically reshape academic performance and learning outcomes.

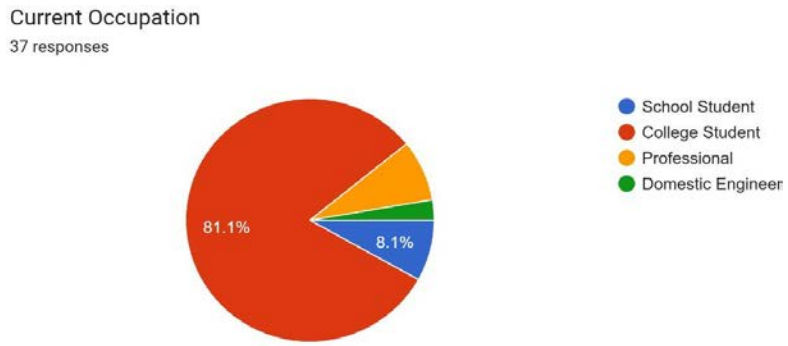
The core of this research lies in identifying the tension between technological assistance and authentic creative expression. While tools like AI can offer sophisticated linguistic support, this study investigates whether this leads to a “leveling up” of student skills or a potential reliance that diminishes independent analytical thought. According to Baker (2018), examining this balance is vital to ensure that technological integration supports rather than replaces the student's own critical and creative development. By analyzing the data gathered through this survey, the study explores the shifting philosophy of what it means to be a “writer” or a “thinker” in an age where algorithms can mimic human syntax, ultimately highlighting how “Human-AI” collaboration is reshaping English studies into a more hybrid, iterative process.

Analysis

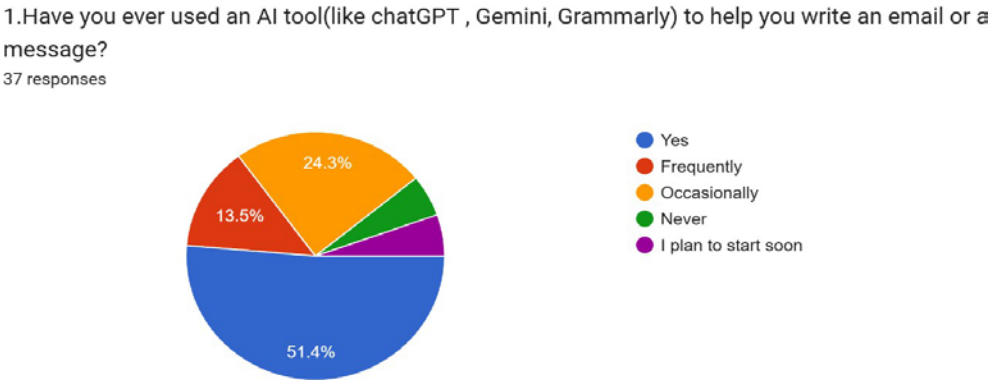


Demographic Overview

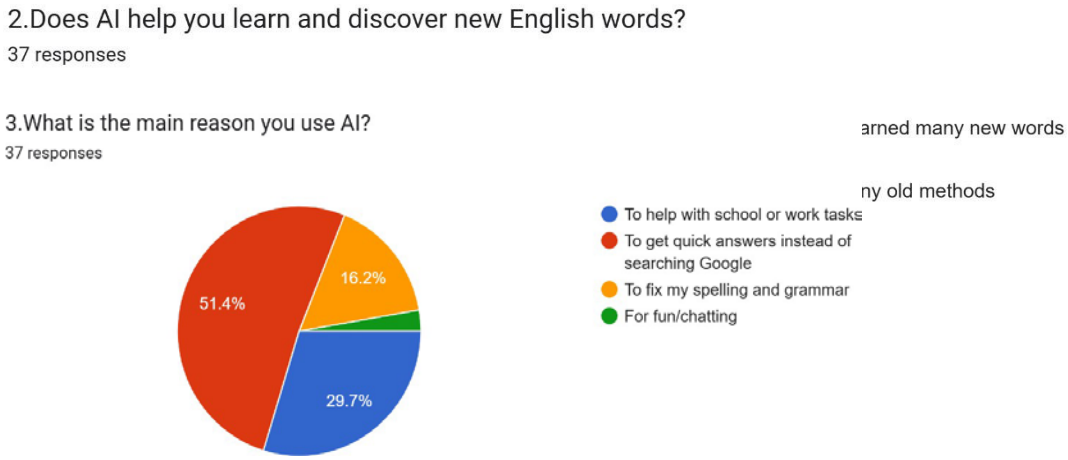
Age Group: The vast majority of respondents (86.5%) fall within the 16-24 age bracket.



Demographic Overview:
Current Occupation: Most participants (81.1%) are college students, indicating that Gen-Z is at the forefront of AI adoption in academia.

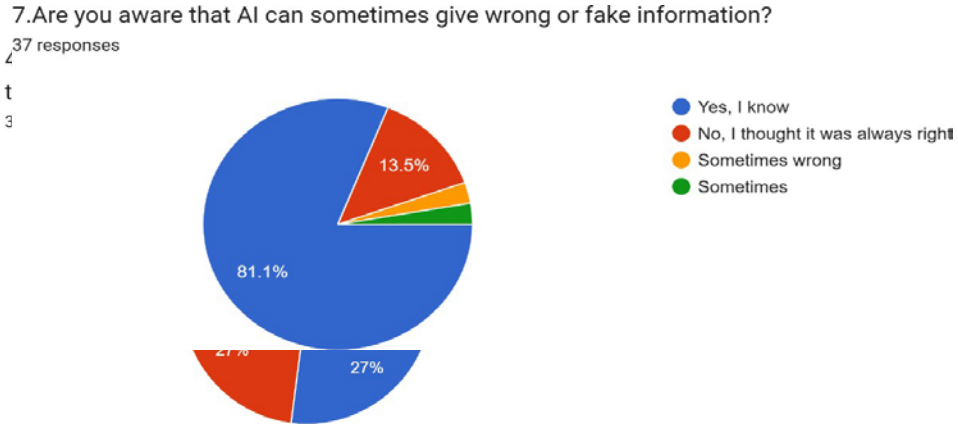


A significant portion of respondents (51.4%) have used AI tools like ChatGPT or Grammarly to help write emails or messages. This suggests that AI is becoming a standard assistant for formal and informal writing tasks

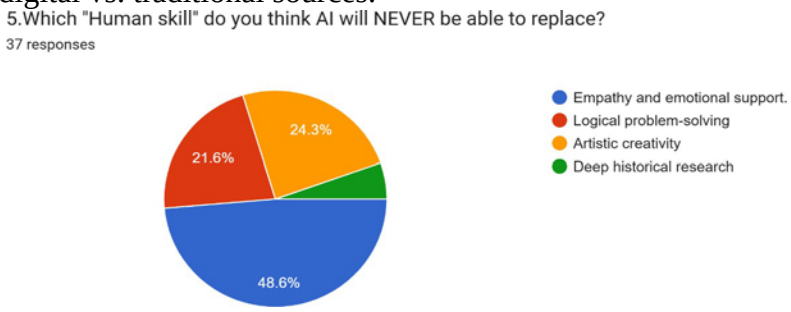


An overwhelming 89.2% of participants agree that AI helps them learn and discover new English words. This highlights AI's role not just as a tool for completion, but as an active educational resource.

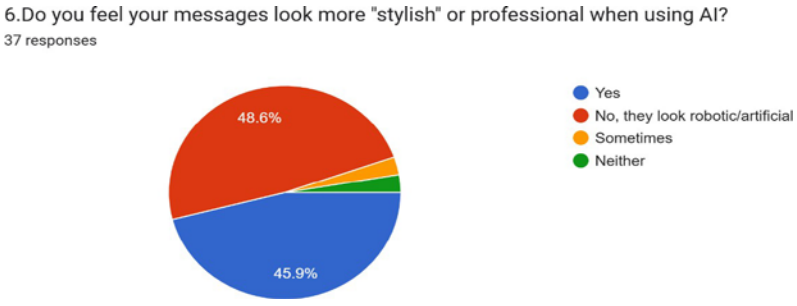
The primary reason for using AI (51.4%) is to get quick answers instead of searching through Google. Speed and directness are clearly the most valued features for current users.



While 45.9% of respondents trust AI and physical textbooks equally, 27% still prefer books due to peer-review and editing. This indicates a balanced perspective on the reliability of digital vs. traditional sources.

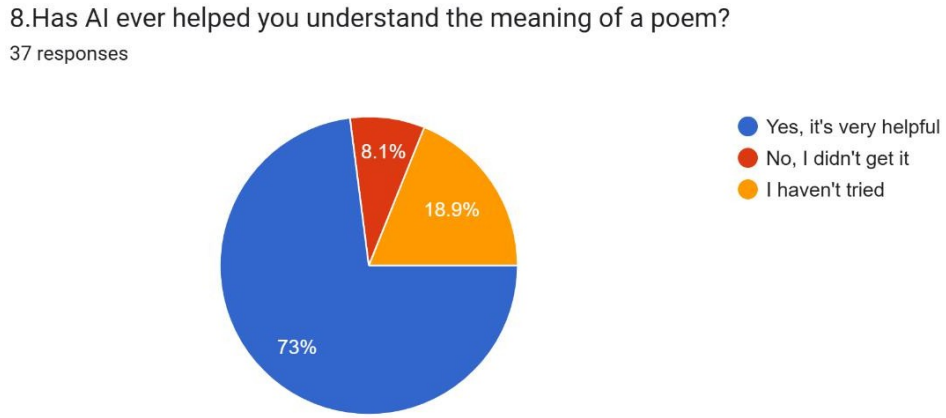


Nearly half of the respondents (48.6%) believe that empathy and emotional support are human skills that AI will never be able to replace. This reinforces the idea that while AI can process information, it lacks the "human touch".

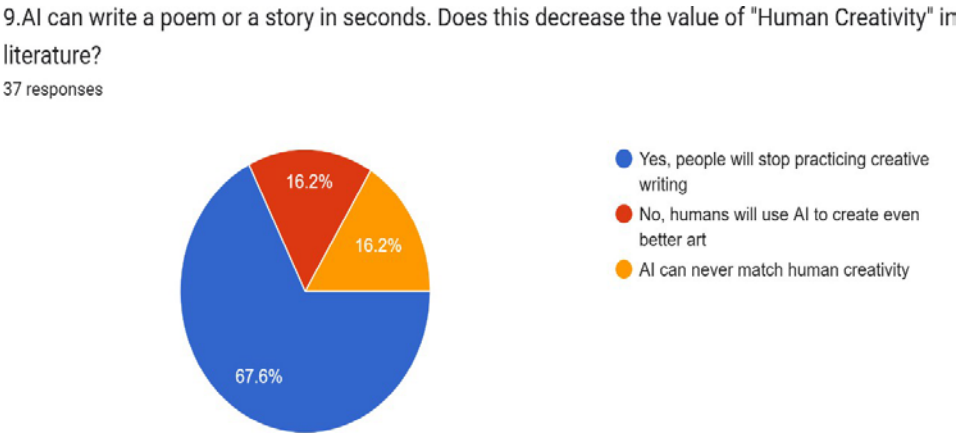


The data shows a split in perception regarding the "style" of AI 45.9% feel it makes messages look more professional or stylish, but 48.6% find the output to be robotic or artificial. This suggests a need for users to personalize AI content to maintain an authentic voice.

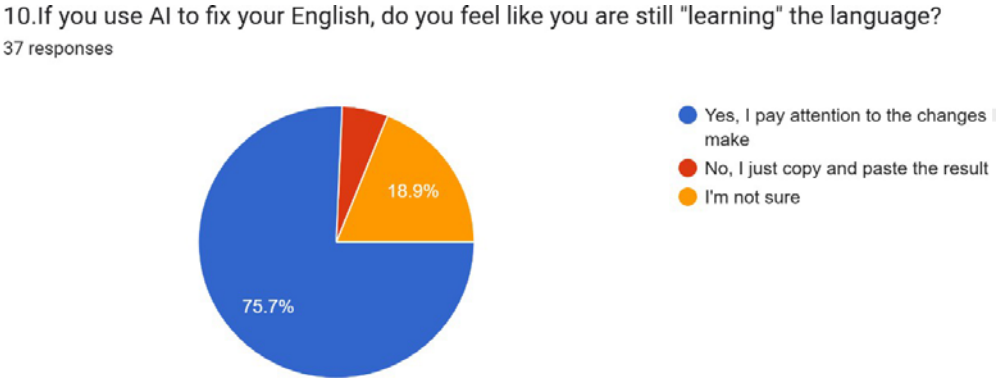
A vast majority of respondents (81.1%) are aware that AI can provide wrong or fake information. This suggests that while users are adopting AI rapidly, they maintain a high level of critical thinking and do not blindly trust digital outputs.



A significant 73% of participants find AI very helpful in understanding the meaning of poetry. This suggests that AI is functioning effectively as a bridge between complex literary texts and student comprehension.



Interestingly, 67.6% of those surveyed believe that AI's ability to generate stories or poems in seconds will cause people to stop practicing creative writing. This suggests a widespread concern that technical efficiency might come at the cost of traditional artistic development.



Even when using AI to fix their English, 75.7% of users claim they still pay attention to the changes being made. This suggests that for most students, AI is used as a learning aid rather than just a “copy-paste” shortcut.

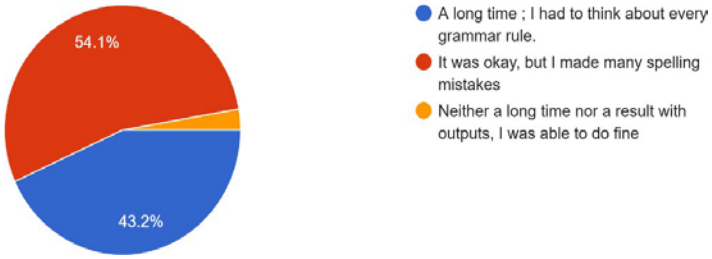
11.When you used a paper dictionary, did you often "accidently" learn other words on the same page?

37 responses

When using paper dictionaries, 64.9% of respondents “accidentally” learned other words on the same page. This suggests that the transition to direct AI answers might be reducing “serendipitous learning”, the discovery of information one wasn't originally looking for.

12.How much time did it take you to write a single English letter or essay without AI help?

37 responses



54.1% of students felt the time taken was "okay" but struggled with accuracy ,43.2% reported it took a long time because they had to manually process every grammar rule. Only a tiny fraction felt they were able to do fine without any struggle. This suggests that while the majority can technically complete a writing task, they lack the "autopilot" skills for spelling and grammar that AI usually provides.

13.Do you think your memory was "stronger" when you had to look up words manually?

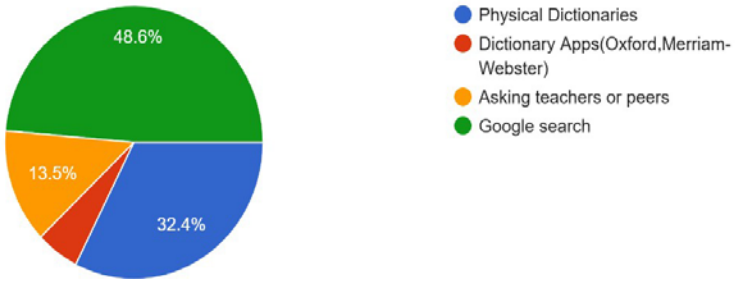
38 responses

It Indicates a clear preference for traditional learning methods, with 60.5% of participants believing their memory was stronger when they looked up words manually in a book. This

suggests that the physical engagement of page-turning creates a more durable mental imprint than digital alternatives. Conversely, only 13.2% of respondents feel that AI actually aids their memory, while 26.3% report no significant difference in retention between manual and digital lookups.

14.Before using AI, what was your primary source for checking word meanings and usage?

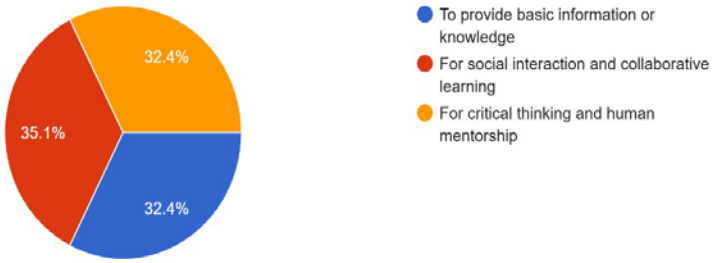
37 responses



Nearly half of the respondents (48.6%) relied on Google search as their primary way to check word meanings before switching to AI. And a significant 32.4% of participants used physical dictionaries, showing that traditional print media still held a strong place in language study. Only 13.5% turned to teachers or peers. This suggests that the transition to AI is not replacing textbooks directly for most users, but rather evolving from the existing habit of using digital search engines to find instant information. It marks a shift from "searching" for a definition to "asking" for one.

15.With AI providing instant answers and language corrections, what do you think the primary role of Schools or colleges today?

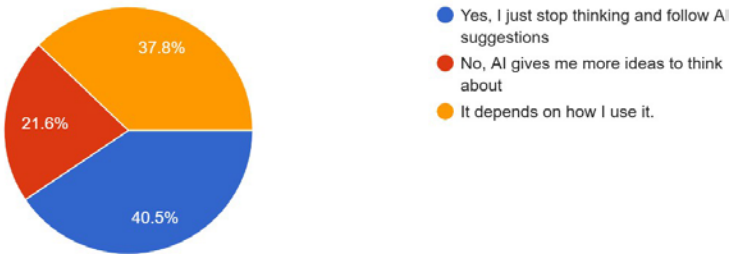
37 responses



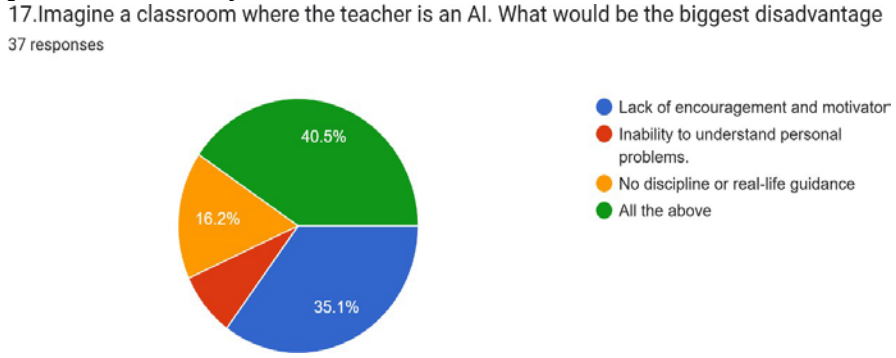
Responses regarding the primary role of educational institutions are evenly split, with 35.1% prioritizing social interaction and collaborative learning, while 32.4% focus on critical thinking and 32.4% on basic information. This suggests that as AI takes over information delivery, the value of schools is shifting toward human-led mentorship and social development.

16.Does using AI for English assignments reduce your ability to think original ideas?

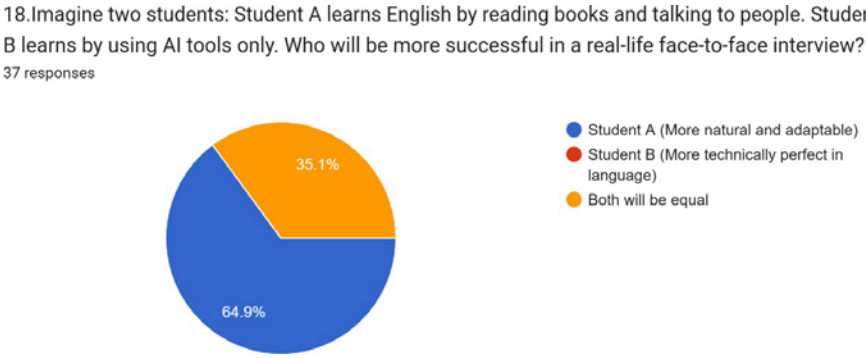
37 responses



A plurality of respondents (40.5%) feel that using AI for English assignments reduces their ability to think of original ideas. This suggests a significant concern among students regarding “intellectual dependency,” where following AI suggestions might replace personal creativity.



When imagining a classroom with an AI teacher, 40.5% of participants cited a combination of factors it lacks encouragement, inability to understand personal problems, and no real-life guidance which is the biggest disadvantage. This suggests that the holistic, emotional, and disciplinary support provided by human teachers is considered irreplaceable by technology.



The survey reveals a strong preference for traditional learning, with 64.9% of respondents believing that real-world interaction makes a candidate more natural and adaptable for interviews. While 35.1% see AI and traditional methods as equally effective, notably 0% of participants felt that relying solely on AI would lead to superior performance. This suggests that while AI is respected for technical accuracy, human-to-human practice remains the gold standard for developing the social nuances required for face-to-face success.

My Comparative Textual Analysis: Human vs. Algorithm

To explore the evolution of literature, my research utilizes the classic ballad "Robin Hood and the Monk"(child, F. J. (Ed.) 1888) as a case study for comparing traditional human interpretation with AI-generated analysis. By contrasting my own critical insights which grounded in historical context and lecture notes against the AI's data- driven decoding of linguistic patterns, aimed to identify the functional gaps between human emotional depth and algorithmic precision. This methodology investigates how 21st-century technology handles 15th-century syntax, ultimately defining the boundary between the AI's technical efficiency and the irreplaceable human touch. By evaluating where the algorithm succeeds

in structural translation and where it falls short in grasping literary nuance, have mapped the essential synergy required for modern English language studies.

My Sequential Human Interpretation: The Soul of the Ballad

Analyzing Robin Hood and the Monk serves as a bridge to the 15th-century human experience, beginning with the "shining shawes" of May that establish the greenwood as a sanctuary of spiritual freedom. This atmospheric opening contrasts sharply with the "fiery strife" between Robin and Little John, where Robin's impulsive vulnerability reveals a psychological depth that transcends the literal text. The narrative's tension peaks at St. Mary's Church as the monk's betrayal transforms a sacred space into a claustrophobic trap, highlighting a profound sense of institutional injustice. Ultimately, the ballad concludes by celebrating character over status, with Little John's clever devotion proving that true loyalty outshines traditional authority.

By tracing this emotional arc from harmony to redemption, it becomes clear that a "human touch" is essential to capturing the pulse of loyalty and betrayal that defines this cultural masterpiece.

My research follows the journey stanza by stanza of the Ballad, THE ROBINHOOD AND THE MONK prioritizing the "Human Soul" over mechanical translation.

The Call of the Greenwood (The Spiritual Start)

The poem begins with a deep connection to nature:

"In somer, when the shawes be sheyne, / And leves be large and long, / Hit is full mery in feyre foreste / To here the foulys song."

From my perspective, this isn't just about the weather. My human soul interprets the "feyre foreste" as a living, breathing sanctuary. Felt the "mery" atmosphere as a representation of divine freedom. Unlike a machine, the birdsong is a celebration of a life lived outside the reach of corrupt laws. This opening establishes a vibrant peace that makes the later betrayal feel like a physical wound.

The Friction of Friendship (The Human Flaw)

When the story moves to the argument between Robin and Little John over a five- shilling wager:

''I have more nede of the, master,' seyd Lytell John, / 'And ye have more nede of me;'
/ 'I shall never owtetake the,' seyd Robyn, / 'Lytell John, I tell the."

Interpret this "fiery strife" as a moment of raw human vulnerability. When Robin strikes his best friend, my soul feels the sting of that blow and the heavy, crushing silence that follows as they part ways. The pride and the stubbornness that define even the greatest heroes. A human researcher like me doesn't just see a dispute; Felt the loneliness of Robin Hood as he walks toward Nottingham alone, realizing too late that he has pushed away his most loyal protector.

The Betrayal at the Altar (The Violation of Peace)

Robin enters the church to seek comfort, but find a villain instead:

"Beside hym stod a gret-hedid munke, / I pray to God woo he be! / Ful well he knew when Robyn came, / And he hym well coude se."

From my perspective, the description of the "gret-hedid munke" is a visceral human observation of a looming, malicious presence. Interpret the monk's immediate recognition of Robin as a moment of chilling dread. When the monk runs to "bar every gate" of the city, my soul reacts to the violation of the sacred space. Translated this scene as the ultimate betrayal—the church, which should be a place of prayer, becomes a cold, urban prison. Felt the suffocating isolation Robin experiences as he is surrounded by the Sheriff's men.

The Clash of Swords (The Physical Struggle) As the Sheriff's men swarm the church:
"Robyn drew out a good swerde, / That was of messer egge; / The Scheryf and his men eche one / Abowt hym they can drege."
In my point of view, this scene is about the desperate instinct for survival. Interpret the "good swerde" not just as a weapon, but as Robin's last hope. Felt the chaos of the fight and the weight of the odds against him. My human interpretation focuses on the bravery of a man fighting for his life in a space where he expected to find God. The exhaustion and the eventual despair when his sword finally breaks, leading to his capture.

The Wit of Loyalty (The Triumph of the Spirit)
Little John's cleverness shines when he tricks the Sheriff and the King:
"'Litull John hath begyled us bothe,' seyd the kyng, / 'And eke the Scheryff of Notyngham.' / 'He is a felow good and true,' seyd the kyng, / 'In all Inglond ar not thre.'"
Interpret this ending as a masterpiece of human devotion. Saw Little John's lies not as sins, but as acts of profound love and wit. When the King acknowledges that there are not three men in all of England as loyal as these outlaws, It as a moral victory where character outweighs social status. My soul celebrates this rescue as a victory for the marginalized.

By following the poem from the peaceful forest to the violent church and back to the triumphant woods, my research proves that the "human touch" is the only tool capable of preserving the emotional truth of literature. This sequential analysis allows me to conclude that while language evolves, the human capacity for loyalty, betrayal, and redemption remains timeless. My Point of view ensures that the "pulse" of the poem is never lost to the mechanical coldness of technology.

Sequential Modern English Translation (AI Output)
Analyzing Robin Hood and the Monk through the lens of data processing reveals that an AI treats the ballad as a linguistic puzzle rather than a work of literature. By employing linguistic substitution for terms like "shawes" and syntactic restructuring for archaic dialogue, the algorithm strips the greenwood of its spiritual essence, reducing a sanctuary to environmental data points and a fractured friendship to a statistical character dispute. This mechanical approach processes the betrayal at the church and Robin's capture as logical plot transitions, entirely bypassing the atmospheric dread and human despair inherent in the narrative. While the AI's precision allows it to map the "skeleton" of 15th-century syntax with incredible speed, it remains restricted to the surface level; it can identify the structure of the story, but it lacks the internal circuitry to experience the "pulse" of loyalty or the "sting" of betrayal. Ultimately, where a human researcher finds a "soul," the AI identifies only structured data through a sequential algorithmic decoding of the stanzas.

Environmental Data Processing (The Opening)
"In somer, when the shawes be sheyne, / And leves be large and long, / Hit is full mery in feyre foreste / To here the foulys song."

From the AI's perspective, these lines are processed as seasonal setting parameters. The algorithm performs a "Linguistic Substitution," identifying the archaic Middle English term "shawes" as "woods" and "sheyne" as "bright." It does not perceive a "sanctuary"; instead, it categorizes the forest as a high-probability location for the narrative. The "mery" atmosphere is recorded as a positive sentiment score based on keyword frequency, but the machine remains neutral to the beauty of the scene.

Conflict Analysis & Sentiment Mapping (The Friction)

"'I have more nede of the, master,' seyd Lytell John, / 'And ye have more nede of me;' / 'I shall never owtetake the,' seyd Robyn, / 'Lytell John, I tell the.'"

When analyzing this dispute, the AI focuses on Syntactic Restructuring. It identifies a "Negative Sentiment" shift between the two primary characters. While a human feels the pain of a broken friendship, the AI merely logs an Interpersonal Conflict Event. It calculates the logic of the dialogue—mapping the refusal of Robin Hood as a plot-triggering action. It cannot detect the "human flaw" of pride; it only sees a deviation from the previous cooperative pattern of the outlaws.

Character Identification & Risk Assessment (The Betrayal)

"Beside hym stod a gret-hedid munke, / I pray to God woo he be! / Ful well he knew when Robyn came, / And he hym well coude se."

The AI views the "gret-hedid munke" through Literal Decoding. It processes "great-headed" as a physical attribute rather than a sign of villainy. From an algorithmic perspective, this is a Character Identification phase. The monk is tagged as an "Antagonist" because his actions (noticing Robin) align with the probability of a

"Betrayal Sequence." The AI does not feel "dread"; it simply calculates the increased risk factor to the protagonist now that his location is compromised in the data.

Tactical Event Summary (The Struggle)

"Robyn drew out a good swerde, / That was of messer egge; / The Scheryf and his men eche one / Abowt hym they can drege."

In my point of view, the AI treats the church battle as a Tactical Interaction. It identifies the "good swerde" as a primary tool for the protagonist. The algorithm summarizes the scene as "Protagonist vs. Multiple Opponents," focusing on the spatial arrangement of the Sheriff's men. It misses the "desperate instinct for survival" that a human researcher senses; instead, it provides a functional summary of a combat sequence where the protagonist's defensive capabilities are eventually depleted.

Resolution & Logic Validation (The Conclusion)

"'Litull John hath begyled us bothe,' seyd the kyng, / 'And eke the Scheryff of Notyngham.' / 'He is a felow good and true,' seyd the kyng, / 'In all Inglond ar not thre.'"

The AI interprets the King's final words as a Resolution of the Narrative Arc. It validates the "loyalty" of Little John as a confirmed character trait based on the success of the rescue mission. While a human soul sees a triumph of the spirit, the algorithm sees a Logical Success Output. It processes the King's praise as a "Positive Conclusion" that satisfies the story's structural requirements.

Findings and Discussion

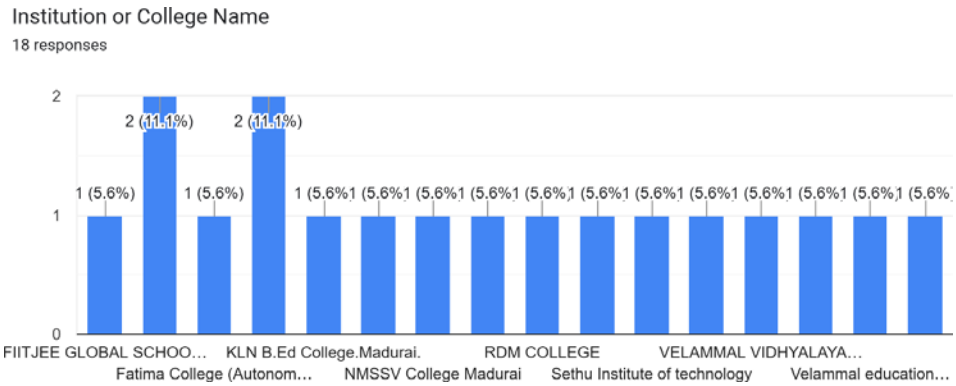
The research proves that AI can masterfully reconstruct the linguistic skeleton of a text, only the human soul can breathe life into its emotional heartbeat.

Table 1.

Feature	Human Perception (The Soul)	Algorithmic Processing (The Skeleton)
Cognitive Approach	Holistic & Empathetic: Integrates personal life experiences and emotions to build a connection with the text.	Reductionist & Logical: Breaks down the text into the smallest possible units (tokens) to analyze mathematical patterns
Linguistic Depth	Semantic Transformation: Captures the "spirit" of the language, translating metaphors and idioms with their original intent.	Syntactic Decoding: Focuses on grammatical accuracy and word-for- word substitution, often losing the hidden meaning.
Cultural Context	Historical Resonance: Understands how a 15th-century ballad reflects the social struggles and geography of that era.	Data Homogenization: Uses generalized global datasets which often ignore regional nuances or specific historical dialects.
Aesthetic Sense	Artistic Appreciation: Recognizes the beauty, rhythm, and "pulse" of a poem as a form of art.	Pattern Recognition: Recognizes rhythm and rhyme only as repetitive structures or sound-wave data.
Final Contribution	Authentic Scholarship: Creates new knowledge and deep emotional bridges between different eras of literature.	Technical Assistance: Acts as a "Cognitive Scaffold" by organizing data and providing quick linguistic breakdowns.

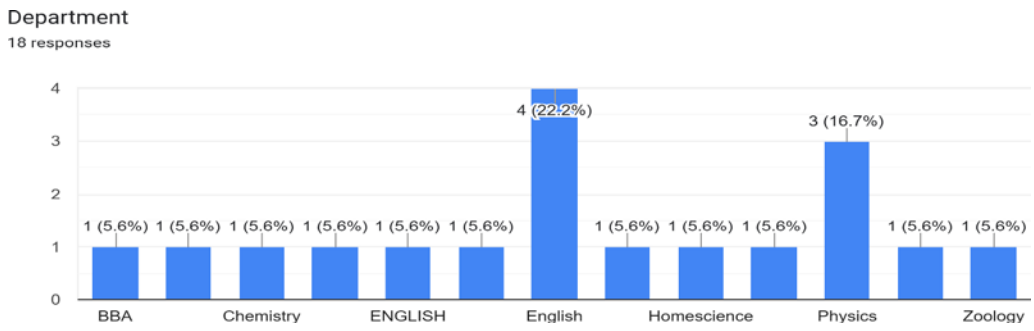
Qualitative Research: My Scholarly Survey with Experts

To provide a comprehensive analysis of my research, conducted a qualitative inquiry with English professors and academic experts via Google Forms to explore the impact of generative intelligence on the humanities. This investigation focused on several critical pillars: the tension between AI's computational precision and human emotion, the shift in the professor’s role toward mentorship and critical discernment, and the evolving core of a college education. By observing whether students utilize AI as alimiting crutch or a creative catalyst, synthesized these high-level perspectives to

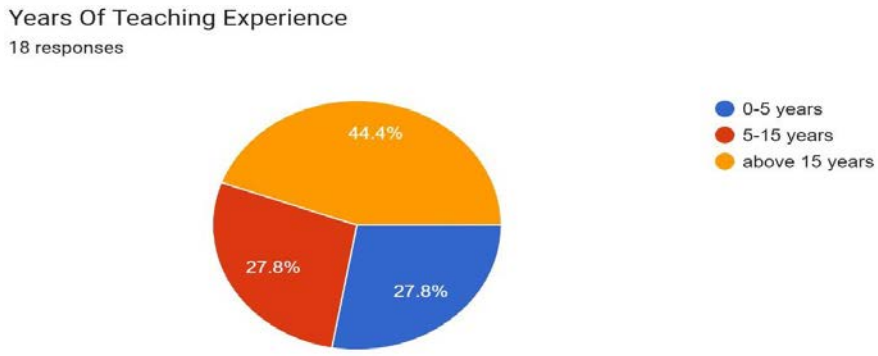


better understand the ethical integration of technology. Ultimately, my findings suggest that while AI can mimic the mechanics of language, the responsibility of preserving an authentic authorial voice and the sanctity of original thought remains uniquely human.

Expert Insights

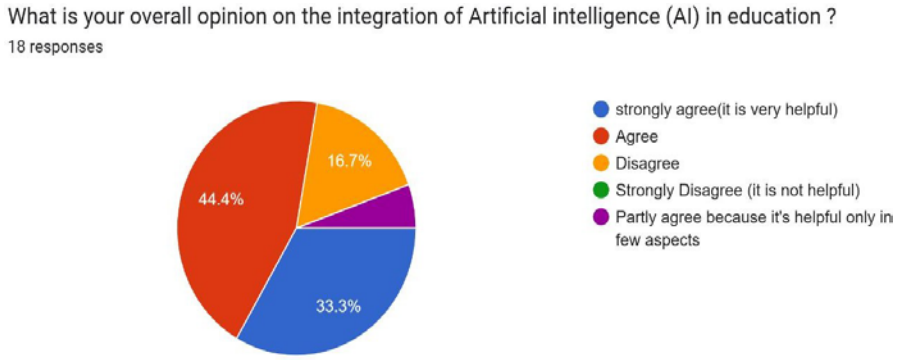


My survey gathered responses from experts across 12 different academic departments, While the insights represent a multidisciplinary perspective, the largest segment of expertise (22.2%) is concentrated within the English Department, providing a solid foundation for analysing language-related AI impacts.

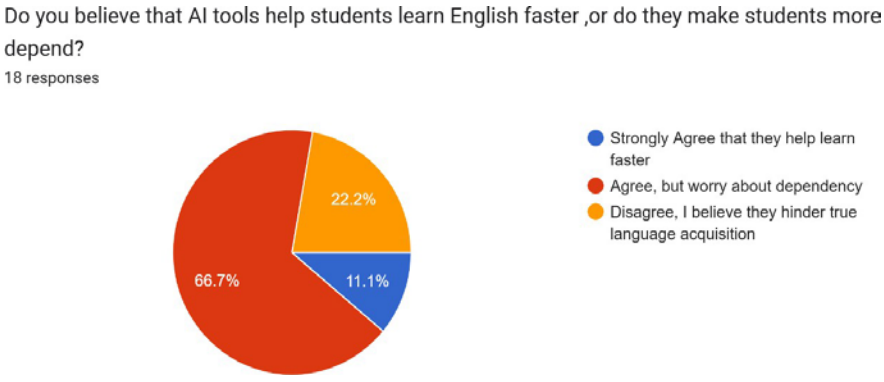


A significant 44.4% of the experts have more than 15 years of teaching experience, ensuring the data is grounded in long-term educational practice.

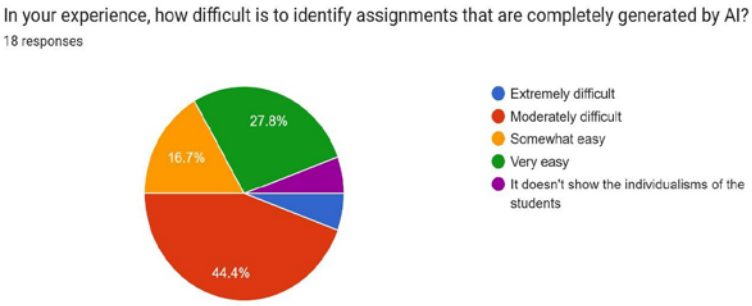
The participants represent various reputable institutions



The majority of respondents (77.7%) view AI as a helpful addition to education. This suggests that AI is no longer a futuristic concept but an accepted tool that stakeholders want to see integrated into classrooms.



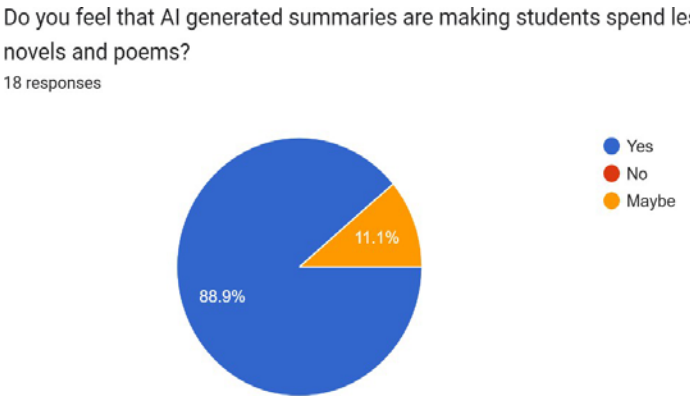
While AI can speed up English language learning, 66.7% of people worry that it makes students too dependent on technology. This suggests that the focus should be on



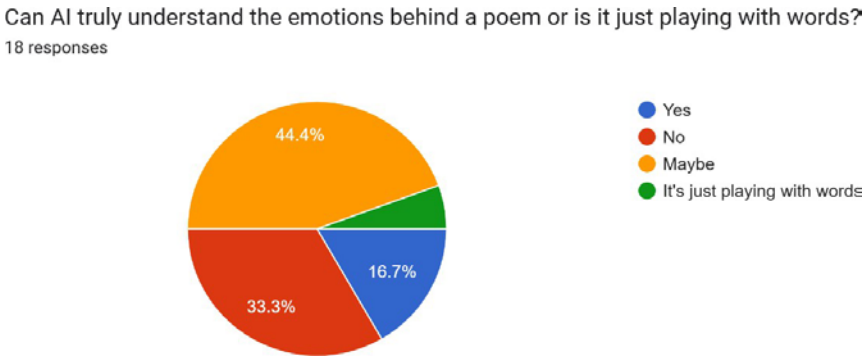
using AI for practice and feedback rather than letting it do the “thinking” for the student.

Nearly 45% find it “moderately difficult” to tell if an assignment was written by AI. This suggests that Teachers need to look for a “lack of individualism” or personal voice as a key indicator of AI use.

Over 94% of respondents believe teacher training for AI is either “absolutely necessary” or "good to have". This suggests that we cannot expect AI to work effectively in schools without first educating the educators on how to manage it.



There is a near-unanimous consensus that AI is altering fundamental study habits, with 88.9% of respondents believing that AI-generated summaries lead students to spend



less time reading original novels and poems. Only 11.1% remain uncertain ("Maybe"), This suggest that we are seeing a shift from “deep reading” to "information scanning.

Only 16.7% believe AI can truly understand emotions, while the rest are either Skeptical or undecided. A combined 38.9% believe it is either definitely not understanding or "just playing with words," and the largest group (44.4%) remains unsure ("Maybe"). This suggest that there is a strong intellectual "trust gap."

How do you see the role of a professor changing in a world where AI can analyse texts instantly?

Expert opinions suggest that while AI significantly alters traditional methodology, it cannot replace the “true professor” who acts as a mentor and facilitator. The educator’s role is shifting from a primary information source to a guide for critical thinking, creativity, and ethical technology use, providing a vital human presence that machines lack. Although growing dependence on AI poses challenges such as students viewing lectures through a purely marks-oriented lens—the teacher remains essential for turning raw data into deep understanding and bridging the gap between automated information

and human wisdom.

What is your opinion on students using AI for their Academic purpose?
According to the qualitative survey conducted among academic experts, the consensus regarding students using AI for academic purposes is that it should be viewed as a “powerful tool with a learning curve” rather than a primary source of knowledge. While the experts acknowledge that AI is “incredibly efficient” for tasks such as “brainstorming, refining grammar, or summarizing complex research,” they strongly emphasize that it must strictly remain a “supportive learning tool”. The overarching advice is that students should use AI as a “learning aid” to “clear doubts,” but they “should not depend on it completely for assignments and learning”. A major concern shared by the respondents is that over-reliance on AI “hinders the critical thinking and creative thinking of students” and significantly reduces their overall “thinking capacity”. There is a collective warning that “total dependency is not encouraged” because it leads to students becoming “lazy” and prevents the “actual aptitude of the students' work” from being accurately judged. Ultimately, the experts believe that while AI is a useful helper, it must be balanced with “self-learning, practice, and teacher guidance" to ensure students do not avoid understanding "basic concepts”.

If AI can provide all the information instantly, what should be the main goal of the college education now?
According to my research into expert academic opinions suggests that while AI offers instant information, it cannot replace the physical classroom’s ability to foster uniquely human traits like emotional intelligence, leadership, and personality development. Consequently, the goal of modern college education is shifting from rote memorization toward cultivating critical thinking, creativity, and the ethical decision- making skills essential for the professional workforce. By prioritizing social relations and the unique bond between professors and students, the formal academic environment ensures a holistic experience that teaches students to apply knowledge effectively and use technology responsibly in real-life contexts.

Materials and Tools Used
To ensure a holistic and evidence-based analysis, my research methodology synthesized traditional scholarship with modern digital exploration, creating a strategic balance between historical foundation and technological innovation. The core academic textbooks utilized across American, British, and Indian literature as a bedrock for textual analysis, establishing a "human" benchmark to evaluate the performance of various Generative AI platforms and plagiarism detection software. This multifaceted approach was further bolstered by quantitative data collected via Google Forms and qualitative insights from peer-reviewed journals and international ethical guidelines. By merging the historical depth of physical textbooks with the analytical speed of cutting-edge software, developed a technically sound and ethically grounded framework that reflects the nuanced reality of Augmented Intelligence. Ultimately, this methodology proves that the future of English studies lies in the informed synergy between human intuition and technological power, where the scholar's expertise guides the machine's precision

Conclusion
My research resolves the debate over linguistic supremacy by demonstrating that human intellect and artificial intelligence occupy distinct yet complementary functional

domains. While AI serves as a powerful “engine” capable of unprecedented speed and structural precision, it remains fundamentally “soulless,” unable to grasp the historical resonance and emotional subtext that define the “heart” of linguistics. By analyzing the Middle English ballad “Robin Hood and the Monk,” conclude that true linguistic excellence lies in Augmented Intelligence—a sacred synergy where technology handles mechanical labor while humans remain the sovereign guardians of meaning and artistic soul. Ultimately, the mystery of superiority vanishes in the realization that AI is merely the mirror, while humanity is the light that provides the reflection with purpose, beauty, and truth, ensuring that the heart of communication remains an eternal human legacy.

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Transforming Education through Artificial Intelligence

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Abstract

Artificial Intelligence is transforming the field of education and changing how students learn across the world. AI-powered tools have greatly influenced learning behaviour, skill development, and academic performance, especially among youth. Today's students are digital learners who use AI tools for studying, problem-solving, research, and completing academic tasks. AI in education includes intelligent tutoring systems, chatbots, virtual classrooms, and adaptive learning platforms. AI has turned traditional classrooms into more interactive and personalized learning environments. Personalized learning is one of the biggest advantages of AI because it adapts content according to the student's ability, learning speed, and interest. This helps students understand subjects better and improve their performance. AI also supports self-paced learning, allowing students to learn anytime and anywhere using online platforms.
It also helps students prepare for future jobs by improving technical and analytical skills. However, there are some challenges in using AI in education, such as overdependence on technology, data privacy issues, reduced creativity, and less human interaction in learning. Artificial Intelligence (AI) is transforming the landscape of education across the globe. Among youth, AI-driven tools have significantly influenced learning behaviour, skill development, and academic performance. This paper explores the opportunities and challenges of AI in education, with special reference to its impact on youth. It highlights how AI enhances personalized learning, improves access to knowledge, and supports skill development, while also raising concerns related to overdependence, ethical use, and digital inequality. The study concludes with recommendations for responsible and effective integration of AI in education systems.

Keywords: Adaptive Learning, Critical Thinking, Education Personalized, Problem-Solving, Self-Paced Learning, Virtual Classroom

Introduction

Artificial Intelligence (AI) is rapidly changing the way education is delivered and experienced in today's digital world. Unlike traditional learning methods, AI creates a more personalized and interactive learning environment where students can study according to their abilities, interests, and pace of understanding. Smart technologies such as virtual classrooms, AI tutors, learning apps, automated assessments, and educational chatbots have made learning easier, faster, and more engaging. Students can now access educational materials anytime and from anywhere, making education more flexible and inclusive. AI also encourages skill development by helping students improve critical thinking, communication, creativity, technical knowledge, and problem-solving abilities, which are essential for success in a modern technology-driven society. However, while AI offers many educational benefits, it also brings certain concerns that cannot be

ignored. Excessive dependence on technology may affect students' independent thinking and reduce real human interaction in classrooms. Issues such as digital inequality, cyber security, misuse of AI-generated content, and lack of access to digital resources remain significant challenges. Even though AI can support teachers by reducing workload and improving teaching efficiency, it cannot replace the emotional connection, motivation, and values shared by educators. Therefore, the future of education should focus on balancing human intelligence with artificial intelligence to create an educational system that is innovative, responsible, and beneficial for every learner.

Review of Related Literature

Several researchers have examined the role of Artificial Intelligence (AI) in transforming the education system and improving student learning experiences. According to recent studies, AI has significantly changed traditional teaching methods by introducing personalized and adaptive learning systems. Researchers have highlighted that AI-powered educational tools help students learn at their own pace, improve academic performance, and increase engagement in learning activities. Studies also reveal that intelligent tutoring systems, virtual classrooms, and automated assessments make education more effective and accessible, especially for students in remote areas

Objectives

1. To study the role of Artificial Intelligence in transforming the education system.
2. To examine the impact of AI on students' learning behaviour and academic performance.
3. To analyse how AI contributes to skill development among youth.

Methodology

The present study is based on a descriptive and analytical research method to understand the impact of Artificial Intelligence (AI) in education. Information was collected to examine how AI influences students' learning behaviour, academic performance, skill development, and teaching methods. The collected data were analysed to identify both the advantages and challenges of AI integration in the educational system. This study particularly focuses on the role of AI among youth and its contribution to modern learning practices.

Analysis

The conceptual framework of this study explains the relationship between **Artificial Intelligence and educational transformation**. AI acts as the independent factor that influences various aspects of education, including **personalized learning, academic performance, skill development, accessibility, and teaching efficiency**. At the same time, certain challenges such as digital inequality, technological dependence, privacy concerns, and reduced human interaction may affect educational outcomes. Therefore, the framework emphasizes that a balanced integration of **AI technology and human teaching** is necessary to achieve effective and inclusive education.

Findings and Discussion

S.NO	AREA OF STUDY	RESULTS OBTAINED	DISCUSSION
1	Personalized Learning	AI-based systems improved personalized learning by adapting lessons according to student ability	Personalized learning helped students understand concepts more effectively.
2	Student Engage	Interactive AI tools increased student participation, interest, and engagement in learning activities.	Virtual simulations, educational games, multimedia content, made learning more attractive and enjoyable for youth learners.
3	Self-Paced Learning	Students were able to learn anytime and anywhere using AI-supported platforms.	Students were able to learn anytime and anywhere using AI-supported platforms.
4	Academic Performance	AI tools contributed to better academic performance and improved understanding of subjects.	Instant feedback, personalized assessments, and adaptive learning systems helped students identify weaknesses

Artificial Intelligence (AI) has become an important part of modern education and has greatly transformed the traditional teaching and learning process. This study, "Transforming Education through Artificial Intelligence," helped in understanding how AI influences student learning behaviour, academic performance, and skill development. AI-powered tools such as virtual classrooms, smart applications, automated assessments, and adaptive learning systems have made education more flexible, interactive, and accessible. One of the greatest advantages of AI is personalized learning, where students can learn according to their own pace and understanding level. It also helps students develop important future skills like critical thinking, communication, problem-solving, creativity, and digital literacy, which are necessary in today's technology-based world. However, despite its benefits, AI in education also presents certain challenges such as overdependence on technology, reduced human interaction, privacy concerns, and unequal access to digital resources. Teachers still play a vital role in guiding, motivating, and emotionally supporting students in ways that technology cannot replace. Therefore, AI should be used as a supportive tool to improve education rather than replace teachers completely. A balanced combination of human intelligence and Artificial Intelligence can

help create a more effective, inclusive, and meaningful educational system for future generations.

Artificial Intelligence (AI) is becoming a very important part of education in today's modern world. From this study, I understood that AI is not only changing the way students learn but also changing the overall teaching and learning process. Earlier, education mainly depended on textbooks, blackboards, and classroom teaching, but now students can learn through online platforms, smart applications, virtual classrooms, and AI-based educational tools. Because of this development, education has become more flexible, easier, and more interesting for students. The study "Transforming Education through Artificial Intelligence" helped me understand how AI influences youth learning behaviour, academic performance, and future career skills.

One of the most useful things about AI in education is that it helps students learn according to their own understanding level. Every student is different, and not everyone can understand lessons at the same speed in a classroom. Sometimes slow learners may struggle, while fast learners may feel bored. AI helps solve this problem because it provides personalized learning experiences according to student needs. Students can spend more time learning difficult topics and move faster in subjects they understand well. In my opinion, this is one of the biggest advantages of AI because it gives equal learning opportunities to all students and helps improve confidence in studies.

I also feel that AI has made learning more interesting for today's generation. Most young people are already connected to technology through mobile phones, computers, and the internet. So, learning through videos, smart applications, educational games, and interactive lessons feels easier and more enjoyable than traditional methods alone. Students can learn anytime and anywhere without depending only on classroom teaching. During difficult situations like the COVID-19 period, online learning became very useful, and many students continued their education because of technology and AI-supported systems. This clearly shows that AI has made education more accessible and flexible. Another important thing I learned from this study is that AI helps students develop important future skills. In today's world, education is not only about scoring marks but also about developing skills for future careers. AI helps students improve problem-solving ability, communication skills, technical knowledge, digital literacy, and creativity. Since future jobs will depend more on technology, students must learn how to use technology wisely. AI-based learning can help prepare students for future challenges and employment opportunities in different fields.

However, while studying this topic, I also realized that AI has some disadvantages if it is not used properly. Many students may become too dependent on technology and stop thinking independently. Sometimes students may simply copy answers from AI tools without understanding the topic deeply. This can affect creativity, originality, and real knowledge. I personally feel that students should use AI only for learning support and not for shortcuts in education. Another concern is reduced communication between teachers and students. Teachers not only teach lessons but also guide, motivate, and support students emotionally. No technology can fully replace the role of a good teacher in shaping a student's future.

Conclusion

Every student does not have equal access to smartphones, laptops, or internet facilities. Some students from villages or poor backgrounds may face difficulties in using AI-based education. Therefore, equal access to digital resources is necessary so that every student can benefit from modern educational systems. Educational institutions and governments should work towards providing better digital facilities and training for students and teachers. To conclude, I believe that Artificial Intelligence has both advantages and disadvantages, but if used correctly, it can bring many positive changes to education. AI makes learning easier, more interesting, personalized, and accessible for students. At the same time, students must learn to use technology responsibly without becoming fully dependent on it. In my opinion, AI should support teachers rather than replace them because human guidance, emotional understanding, and classroom interaction are still very important in education. The future of education will become stronger if we successfully combine human intelligence with Artificial Intelligence in a balanced and meaningful way.

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What if AI Becomes Your Best Friend?

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Abstract

Artificial Intelligence (AI) has rapidly evolved from a functional tool into an interactive companion capable of mimicking human conversation, emotions, and decision making. This paper explores the possibility of AI becoming "best friend" and examines its implications on human relationships, education, and emotional well-being. The study aims to understand how AI companionship influences human behaviour, social interaction, and dependency. A qualitative approach is used, analysing existing literature, case studies, and real-world AI applications such as chatbots and virtual assistants. The findings reveal that while AI personalized learning, and constant availability, it also raises concerns regarding emotional dependency, reduced human interaction, and ethical boundaries. The paper concludes that AI friendship can be beneficial when balanced with real human relationships, emphasizing the need for ethical guidelines and responsible usage.

Keywords: Artificial Intelligence, AI Companionship, Digital Relationships, Emotional Intelligence, Human-AI Interaction

Introduction

Artificial Intelligence has become an integral part of modern life, influencing communication, education, healthcare, and entertainment. Traditionally, machines were designed to perform tasks efficiently; however, recent advancements have enabled AI to simulate human-like conversations and emotional responses. This transformation raises an intriguing question: What if AI becomes your best friend?

Human beings are naturally social and emotional, seeking companionship, understanding, and support. With increasing digitalization and reduced face-to-face interactions, AI systems such as virtual assistants and chatbots are beginning to fill emotional gaps. These systems can listen, respond, and adapt to users, creating a sense of connection.

In education, AI-driven platforms provide personalized learning experiences, while in daily life, AI companions assist in decision-making and mental well-being. However, the idea of replacing human friendship with artificial companionship brings both opportunities and challenges.

Review of Related Literature

Artificial Intelligence has evolved from a functional tool into an interactive companion capable of mimicking human conversation and emotions (Russell & Norvig, 2021). Studies highlight that AI systems, including chatbots and virtual assistants, increasingly

support communication, learning, and decision-making, fostering human–AI interaction (Bickmore & Picard, 2005). However, concerns about emotional dependency and reduced human relationships persist (Turkle, 2017). The broader societal impact of AI companionship is linked to technological transformation and ethical considerations (Brynjolfsson & McAfee, 2018; Floridi et al., 2018), emphasizing the need for responsible and balanced integration

Objectives

This paper explores the potential of AI as a best friend by analyzing its benefits, risks, and long-term impact on society.

Methodology

This study adopts a qualitative research methodology using descriptive analysis. The research is based on secondary data collected from:

- Research articles on Artificial Intelligence and human interaction
- Case studies of AI companions (e.g., chatbots, virtual assistants)
- Books and online resources related to AI ethics and psychology
- The data were analysed thematically under the following categories:
- Emotional Support and Companionship
- Educational Assistance
- Social and Psychological Impact
- Ethical and Privacy Concerns

The study framework is based on human-centered AI theory, focusing on how technology aligns with human needs and values.

Findings and Discussion

The major findings of the study are summarized in Table 01.

Table 01: Impact of AI as Best Friend

Themes	Findings
Emotional Support	AI can provide constant companionship, reduce loneliness, and offer non-judgemental interaction.
Educational Benefits	AI acts as a personalised tutor, helping students learn at their own pace with instant feedback.
Availability	AI is accessible 24/7, making it a reliable companion in times of need.
Social Impact	Excessive dependence on Ai may reduce real human interactions and social skills.
Psychological Effects	Users may develop emotional attachment or dependency on AI systems.
Ethical Concerns	Issues related to data privacy, trust, and emotional manipulations arise.

Discussion	The concept of AI as a best friend presents both positive and negative dimensions. On one hand, AI companionship can support individuals who feel isolated, offering comfort and guidance. For students, AI can Act as a mentor, simplifying complex concepts and improving academic performance. On the other hand, over-reliance on AI may weaken human relationships. Emotional dependency on machines could lead to detachment from real-world interactions. Furthermore, ethical concerns such as data misuse and lack of transparency must be addressed. Thus, while AI can complement human friendship, it should not replace it entirely.

Conclusion

The idea of AI becoming a best friend is no longer a futuristic concept but an emerging reality. AI has the potential to enhance emotional well-being, improve education, and provide continuous support. However, it also poses risks related to dependency, social isolation, and ethical challenges.

A balanced approach is essential, where AI is used as a supportive tool rather than a replacement for human relationships. Future developments should focus on ethical AI design, ensuring that technology enhances human life without compromising emotional and social values.

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AI, Media, and Technology in Education

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Abstract

Artificial Intelligence (AI), media, and modern technology are transforming the education sector by improving teaching methods, enhancing learning experiences, and increasing accessibility to knowledge. AI-powered tools such as virtual tutors, chatbots, adaptive learning systems, and automated assessment platforms help students learn according to their individual abilities and pace. Media technologies including digital videos, online learning platforms, podcasts, and interactive content make education more engaging and effective. Technology also supports remote learning, collaboration, and communication among students and teachers across the world. However, the integration of AI and technology in education also creates challenges such as data privacy concerns, digital inequality, excessive screen time, and dependence on automated systems. Despite these challenges, the proper use of AI and media technologies can improve educational quality, creativity, critical thinking, and student performance. This paper discusses the role, advantages, challenges, and future impact of AI, media, and technology in modern education systems.

Keywords: Artificial Intelligence, Digital Learning, Educational Technology, Media in Education, Smart Learning

Introduction

Education has changed significantly with the rapid development of technology. Traditional classroom teaching methods are now supported by digital platforms, online resources, and intelligent learning systems. Artificial Intelligence (AI) has become one of the most important innovations in education because it helps personalize learning and improves academic performance. AI systems can analyze student behaviour, identify learning gaps, and provide customized learning materials.

Media and technology also play a major role in making education interactive and accessible. Educational videos, social media platforms, virtual classrooms, and multimedia presentations help students understand concepts more easily. During recent years, especially after the growth of online learning, technology has become an essential part of education systems worldwide.

The use of AI and technology benefits both teachers and students. Teachers can automate repetitive tasks such as grading and attendance management, while students can access learning materials anytime and anywhere. Technology also encourages collaborative learning through online discussions, digital assignments, and virtual teamwork.

However, the increasing use of technology in education also raises certain concerns. Issues such as cyber security, lack of internet access in rural areas, reduced face-to-face communication, and overdependence on digital tools may affect the quality of education. Therefore, educational institutions must ensure responsible and balanced use of technology.

Objectives

The objective of this paper is to analyze the importance of Artificial Intelligence, media, and technology in education, along with their advantages, challenges, and future developments.

Methodology

This study is based on qualitative research using secondary data collected from journals, educational websites, books, and research articles related to Artificial Intelligence and educational technology. Information regarding AI tools, digital learning platforms, and media technologies was analyzed to understand their impact on modern education systems.

Different educational technologies such as smart classrooms, online learning applications, virtual learning environments, and AI-based assessment systems were examined. The study also reviewed recent developments in educational media and technology integration in schools and universities.

Analysis

Role of Artificial Intelligence in Education

Artificial Intelligence improves the learning process by providing personalized education. AI-powered applications can monitor student progress and recommend suitable learning materials according to individual performance. Intelligent tutoring systems help students practice difficult subjects with immediate feedback and guidance.

AI also reduces teachers' workload through automated grading systems, attendance tracking, and administrative support. Chatbots and virtual assistants provide instant responses to student questions and improve communication between institutions and learners.

Importance of Media in Education

Media technologies such as videos, animations, podcasts, and educational websites make learning more interesting and understandable. Visual and audio content improves student attention and memory retention. Platforms like virtual classrooms and online conferencing tools allow students to continue education remotely.

Social media also supports collaborative learning by enabling students to share knowledge, participate in discussions, and access educational communities. Digital media encourages creativity and innovation among learners.

Impact of Technology on Modern Learning

Technology has made education more flexible and accessible. Students can learn from anywhere using smartphones, tablets, and computers. Online learning platforms provide access to global educational resources and courses. Smart classrooms equipped with

digital boards, projectors, and internet connectivity improve classroom interaction and participation.

Technology also supports inclusive education for students with disabilities through speech recognition tools, screen readers, and assistive learning software.

Challenges of AI and Technology in Education

Despite its advantages, technology integration in education has certain limitations. Lack of internet access and digital devices creates inequality among students. Excessive dependence on technology may reduce critical thinking and face-to-face communication skills. Data privacy and cyber security are also major concerns because educational platforms collect large amounts of student information. In addition, some teachers and students may face difficulties adapting to advanced technologies due to lack of technical knowledge or training.

Future of AI and Educational Technology

The future of education will increasingly depend on AI-driven systems and digital technologies. Virtual Reality (VR), Augmented Reality (AR), and intelligent learning platforms are expected to create immersive learning experiences. AI may further improve personalized learning, skill development, and career guidance systems.

Educational institutions must focus on ethical AI usage, digital literacy, and equal access to technology to ensure better educational outcomes in the future.

Personalized Learning through AI

One of the major advantages of Artificial Intelligence in education is personalized learning. Traditional classrooms usually follow the same teaching method for all students, even though students have different learning abilities and interests. AI-based learning systems analyze student performance and provide customized lessons according to individual needs.

Adaptive learning platforms can identify weak areas of students and suggest suitable exercises, quizzes, and study materials. This helps students improve their understanding and confidence. Personalized learning also increases student motivation because learners can progress at their own pace without pressure.

AI-powered educational applications also support self-learning by providing instant feedback and recommendations. Students can learn independently outside the classroom using mobile applications and virtual tutors.

Smart Classrooms and Digital Learning

Smart classrooms are modern learning environments equipped with advanced technologies such as interactive whiteboards, projectors, internet connectivity, and digital learning tools. These classrooms make teaching more interactive and visually attractive. Teachers can use multimedia presentations, animations, and simulations to explain complex topics easily.

Digital learning platforms provide students access to recorded lectures, e-books, assignments, and online assessments. Cloud-based learning systems allow students to continue learning anytime and anywhere. This flexibility improves educational accessibility and supports lifelong learning.

Smart classrooms also encourage student participation through online quizzes, polls, and collaborative activities. Technology-based learning environments improve communication between teachers and students.

Role of Social Media in Education

Social media platforms have become important tools for communication and knowledge sharing in education. Applications such as discussion forums, educational channels, and online communities allow students to exchange ideas and learning resources.

Teachers use social media to share announcements, educational videos, notes, and assignments. Students can participate in group discussions and collaborate on academic projects through digital platforms. Educational content creators also provide free tutorials and skill-based learning opportunities through media platforms.

However, excessive use of social media may distract students from academic activities. Therefore, students should use social media responsibly for educational purposes.

Virtual Reality and Augmented Reality in Education

Virtual Reality (VR) and Augmented Reality (AR) are advanced technologies that create immersive learning experiences. VR allows students to enter simulated environments and interact with virtual objects. AR combines digital information with the real-world environment.

These technologies improve practical understanding in subjects such as science, medicine, engineering, and history. For example, medical students can practice surgeries in virtual environments, while engineering students can study machine structures using 3D models.

VR and AR increase student engagement and make learning more enjoyable. They also improve memory retention because students learn through visual and interactive experiences.

Online Learning and Distance Education

Online learning has become highly popular due to technological advancements and internet accessibility. Educational institutions now offer online courses, certifications, and virtual degree programs. Students can attend classes remotely using video conferencing platforms and learning management systems.

Distance education helps students continue their studies without geographical limitations. It is especially useful for working professionals, rural students, and learners with physical disabilities. Online learning also reduces travel expenses and provides flexibility in study schedules.

Despite these advantages, online education may create challenges such as lack of personal interaction, technical issues, and reduced concentration during virtual classes.

Findings and Discussion

Benefits of AI , Media , and Technology in Education

The integration of AI and technology in education offers numerous benefits:

- Improves student engagement and participation
- Provides personalized learning experiences
- Saves teachers' time through automation
- Supports remote and flexible learning
- Enhances communication and collaboration
- Increases access to global educational resources
- Helps students develop digital and technical skills
- Encourages creativity and innovation

Technology also prepares students for future careers in a digital world.

Ethical Issues and Challenges

Although AI and technology provide many advantages, ethical concerns must be considered carefully. AI systems collect and store large amounts of student data, which creates privacy and security risks. Educational institutions must protect sensitive information from cyber threats and misuse.

Another challenge is digital inequality. Many students in rural or economically weaker areas do not have proper internet access or digital devices. This creates an educational gap between students.

Overdependence on technology may also reduce human interaction, creativity, and independent thinking skills. Therefore, technology should support education rather than completely replace teachers.

Future Trends in Educational Technology

The future of education will be strongly influenced by AI and advanced technologies. Intelligent tutoring systems, virtual laboratories, and AI-based career guidance tools are expected to become more common in educational institutions.

Blockchain technology may also be used to securely store academic records and certificates. Artificial Intelligence could help institutions predict student performance and provide early support for struggling learners.

Future classrooms may combine physical and virtual learning environments to create hybrid education systems. Educational technology will continue improving accessibility, efficiency, and quality of learning worldwide.

Gamification in Education

Gamification refers to the use of game elements such as rewards, points, badges, and challenges in educational activities. Technology-based gamification increases student engagement and motivation in learning.

Educational games and quiz applications encourage students to participate actively in classroom activities. Gamified learning environments improve problem-solving skills, creativity, teamwork, and decision-making abilities.
Students often feel more motivated to complete tasks and achieve academic goals when learning becomes enjoyable and interactive. Gamification also reduces stress and boredom during learning sessions.

Advantages and Challenges of AI in Education

Advantages	Challenges
Personalized learning	Data privacy concerns
Faster evaluation process	High implementation cost
Flexible online education	Internet dependency
Better student engagement	Digital inequality
24/7 learning support	Reduced face-to-face interaction

Conclusion

Artificial Intelligence, media, and technology are transforming education by making learning more interactive, personalized, and accessible. AI systems help improve academic performance and reduce teachers' workload, while media technologies increase student engagement and understanding. Modern educational technologies support flexible and collaborative learning environments.

However, challenges such as digital inequality, privacy concerns, and overdependence on technology must be addressed carefully. Proper planning, teacher training, and ethical implementation of AI can maximize the benefits of technology in education. Overall, AI and modern technology have the potential to create a smarter, more efficient, and inclusive education system for future generations.

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Artificial Intelligence for Enhancing Nutrition Education in Early Childhood

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Abstract

Early childhood is a critical phase for the development of dietary habits and long-term health outcomes. During this stage, children are highly impressionable, and their food preferences and eating behaviours are strongly influenced by their immediate environment, including family, school, and media exposure. Establishing healthy nutritional practices at this age is essential for preventing future health complications and promoting overall well-being. This study focuses on understanding the role of school-based nutrition education interventions in shaping the knowledge, attitudes, and practices of young children. A comprehensive review of existing literature was conducted, analyzing studies on classroom-based teaching methods, activity-based learning, and parental involvement programs. The collected data from various research articles were systematically examined to identify patterns and outcomes associated with these interventions. Recent advancements in artificial intelligence have also been considered, particularly the use of AI-based educational applications, interactive learning platforms, and personalized content delivery systems that enhance engagement among young learners. The findings indicate that structured nutrition education significantly improves children's awareness and promotes healthier food choices, especially when combined with family participation and technology-supported learning. However, challenges such as limited resources, inadequate teacher training, and external influences like media and food marketing persist. In conclusion, integrating innovative teaching strategies, including artificial intelligence, can strengthen early childhood nutrition education and contribute to the development of sustainable healthy habits and improved public health outcomes.

Keywords: Artificial Intelligence, AI-based educational applications, Early childhood, Nutrition Education, School-based educational interventions.

Introduction

Early childhood is a crucial stage of development, during which foundational habits related to health, behavior, and learning are established. Nutritional practices formed during these early years play a significant role in influencing long-term health outcomes, including physical growth, cognitive development, and prevention of chronic diseases. In recent years, increasing concerns regarding unhealthy dietary patterns among children have highlighted the need for more effective and engaging approaches to nutrition education at an early age.

Traditional methods of nutrition education, such as classroom instruction and activity-based learning, have been successful in improving awareness among children. However, these approaches often lack personalization and sustained engagement, thereby limiting their overall effectiveness. With the rapid advancement of digital technologies, educational practices are evolving to incorporate more interactive and learner-centered strategies in the classroom.

Artificial intelligence (AI) has emerged as a transformative tool in education, enabling the development of adaptive and personalized learning environments. AI-driven applications, mobile platforms, and gamified systems allow educational content to be tailored to individual learning needs, thereby enhancing engagement and knowledge retention. In particular, the integration of AI with gamification and immersive technologies has shown potential in making nutrition education more interactive and appealing for young learners.
Despite these advancements, the application of AI in early childhood nutrition education remains relatively underexplored. Existing studies primarily focus on general digital learning tools, with limited emphasis on the specific role of AI in shaping nutritional knowledge and behaviour among young children. Therefore, this study aims to systematically review the existing literature on the role of artificial intelligence in early childhood nutrition education, focusing on the types of AI-based interventions, their effectiveness, and their impact on learning outcomes, while also identifying key research gaps in this emerging field.

Review of Related Literature

This section critically examines the existing research on the application of artificial intelligence (AI) in early childhood nutrition education. It focuses on the types of technologies used, their educational applications, observed outcomes, and the limitations identified in the studies.

AI Technologies in Early Childhood Education

Studies indicate that AI technologies such as adaptive learning systems, intelligent tutoring platforms, and gamified applications are increasingly being integrated into early childhood education (Rosati et al., 2025; Oshinowo et al., 2025). These technologies enable personalized learning experiences by adjusting content according to individual progress and performance, which has been associated with improved engagement and enhanced knowledge retention among young learners.

Applications of AI in Nutrition Education

Research suggests that AI-driven tools, particularly gamified platforms and augmented reality applications, are effective in simplifying complex nutritional concepts for the target audience (Rosati et al., 2025; Capecchi et al., 2025). By presenting content through interactive and visually engaging formats, these technologies improve comprehension and encourage positive learning experiences related to nutrition among children.

Impact of AI-Driven Interventions on Child Nutrition Outcomes

Existing studies have reported that AI-based interventions contribute to increased motivation, higher engagement levels, and improved knowledge acquisition (Hedaoo & Vali, 2015; Rosati et al., 2025). However, most findings are based on short-term evaluations, and there is limited evidence regarding the long-term impact of these interventions on sustained dietary behaviours and overall health outcomes.

Challenges and Limitations in Existing Research

The literature also highlights several challenges, including unequal access to digital resources, differences in digital literacy, and the limited availability of age-appropriate AI-based content. Additionally, concerns related to data privacy, ethical considerations, and excessive screen exposure have been identified as barriers to the effective implementation of AI in early childhood settings (Oshinowo et al., 2025).

Critical Analysis

A critical review of the studies reveals that, although AI demonstrates strong potential in enhancing nutrition education, current research remains fragmented and often limited in scale. The absence of standardized methodologies and long-term studies restricts the ability to draw definitive conclusions regarding the effectiveness and scalability of AI-driven approaches.

Relevance to the Present Study

Overall, the study highlights both the opportunities and limitations associated with AI in early childhood nutrition education. These findings underscore the need for more comprehensive and systematic research, which this study aims to address by analyzing existing evidence to better understand the role and future potential of AI in this field.

Objectives

The primary objective of this study is to examine the role of artificial intelligence (AI) in enhancing early childhood nutrition education, with a focus on improving learning outcomes, engagement, and healthy behavioral development among young children. The study aims to explore how emerging technologies can be effectively integrated into educational practices to address current limitations in traditional nutrition education methods.

The specific objectives of the study are:

- To analyze the different types of artificial intelligence technologies utilized in early childhood education, particularly those applied in the context of nutrition learning and health education.
- To examine the application of AI-driven tools, including gamified platforms, interactive applications, and adaptive learning systems, in delivering nutrition-related content to young children in an engaging and accessible manner.
- To evaluate the effectiveness of AI-based interventions in enhancing children’s knowledge, improving engagement levels, and influencing positive nutritional behaviors.
- To identify and critically assess the key challenges, limitations, and ethical concerns associated with the use of AI in early childhood nutrition education, including issues related to accessibility, digital literacy, and data privacy.
- To explore existing gaps in the current body of research and highlight areas that require further investigation, particularly with respect to long-term impacts and large-scale implementation of AI-based educational strategies.
- To provide insights and recommendations for the effective integration of AI technologies in early childhood nutrition education, with the aim of supporting the development of more personalized, interactive, and sustainable learning approaches.

Methodology

This literature review systematically examines existing research on the application of artificial intelligence (AI) in early childhood nutrition education. The review process involved the following steps:

Literature Search Strategy

A comprehensive search was conducted across multiple academic databases, including Google Scholar, PubMed, and Science Direct, along with peer-reviewed journals, conference proceedings, and relevant gray literature. Keywords and phrases such as "artificial intelligence," "early childhood," "nutrition education," "AI in education," and related terms were used to identify pertinent studies published between 2014 and 2025. Inclusion criteria focused on studies involving AI technologies applied to nutrition education for children aged 3 to 6 years.

Selection and Screening

Identified records were screened through a two-stage process: initial title and abstract review followed by full-text assessment. Studies were included if they addressed AI-driven interventions, educational tools, or frameworks targeting nutrition knowledge or behavior in early childhood settings. Exclusion criteria eliminated studies not directly related to AI or nutrition education within the specified age group. A total of 8 studies meeting the inclusion criteria were selected for final analysis.

Quality Assessment

Quality assessment criteria, including study design, sample size considerations, and methodological rigor, were applied to ensure robustness and validity of the included studies.

Data Extraction and Synthesis

Key information was extracted from selected studies, including AI methodologies employed (e.g., machine learning, natural language processing), educational approaches, types of nutrition content delivered, and reported outcomes. The extracted data were systematically organized into thematic categories to identify common patterns, technological trends, pedagogical strategies, and gaps in current research.

Critical Analysis

The review critically evaluated the effectiveness, usability, and engagement aspects of AI applications in early childhood nutrition education. Methodological quality and limitations of the included studies were also assessed to contextualize findings and inform recommendations for future research.

This structured methodology ensures a comprehensive understanding of the current landscape of AI in early childhood nutrition education, highlighting both advancements and areas requiring further exploration.

Analysis

The selected literature was organized into six major themes based on technological integration, educational methodology, behavioural outcomes, and the application of AI in early childhood nutrition education. These themes include:

(a) AI-powered nutrition education platforms

(b) gamification and game-based learning
(c) AI integration in cognitive development
(d) augmented reality and multimedia technologies
(e) inclusivity and accessibility
(f) sustainability and future directions.

Across the reviewed studies, measurable improvements were observed in learner engagement, cognitive development, nutritional awareness, food preference behaviour, instructional efficiency, and emotional participation following AI-supported interventions. The findings demonstrate that artificial intelligence is transforming nutrition education from passive content delivery into an interactive, adaptive, and behaviour-oriented learning process suited to early childhood environments.

AI-Powered Nutrition Education Platforms

AI-powered nutrition education platforms represent a significant advancement in educational technology. These systems integrate adaptive learning, predictive analytics, intelligent monitoring, and personalized feedback to enhance children's learning experiences (Oshinowo et al., 2025). Research indicates that AI systems can tailor nutritional guidance based on age, dietary behaviour, cognitive ability, learning pace, and behavioural responses. This level of personalization improves engagement by replacing static instruction with dynamic, real-time interaction. Empirical findings further support this impact. For instance, studies reported a 74% improvement in learner engagement and a 19% increase in attention span, indicating that AI-supported environments promote sustained focus and active participation. Additionally, cognitive outcomes improved significantly, with 68% enhancement in learning performance, alongside increases in literacy (22%) and numeracy skills (17%). These results suggest that AI not only supports nutrition education but also contributes to overall developmental learning. Teacher efficiency also improved, with a 31% reduction in routine tasks and 67% improvement in lesson planning efficiency, highlighting the dual benefit of AI in both teaching and learning processes (Oshinowo et al., 2025). However, challenges persist. A notable 42% of educators reported insufficient AI training, indicating that successful implementation depends heavily on professional development and institutional support. Furthermore, issues related to scalability, infrastructure, and long-term behavioural impact remain key research gaps.

Gamification and Game-Based Learning in Nutrition Education

Gamification emerged as a highly effective approach for enhancing engagement and motivation in nutrition education. Game-based learning environments incorporate reward systems, interactive challenges, and feedback mechanisms that encourage active participation. Studies consistently demonstrate that gamified interventions lead to higher levels of engagement and improved nutritional awareness compared to traditional teaching methods. The integration of behavioural tracking and adaptive challenges further enhances personalization and sustained interest. For example, increased attention levels observed in gamified systems (up to 19%) indicate that interactive elements significantly improve focus and participation (Rosati et al., 2025). Additionally, gamification supports emotional engagement and knowledge retention by combining entertainment with educational objectives.

Despite these strengths, limitations remain. Most studies were conducted over short durations with small sample sizes, making it difficult to assess long-term behavioural

change. Furthermore, variations in evaluation methods—ranging from engagement metrics to behavioural outcomes—limit direct comparison across studies.

AI Integration in Early Childhood and Cognitive Development

AI-supported multimedia learning plays a crucial role in enhancing cognitive development during early childhood. The reviewed studies demonstrate substantial improvements in both knowledge acquisition and behavioural outcomes. One intervention reported an increase in correct responses from 38.79% to 75.89%, indicating a significant improvement in nutrition knowledge. Similarly, behavioural changes were evident, with preference for healthy food increasing from 40% to 97%, while unhealthy food preference decreased dramatically (Hedaoo & Vali, 2015). These findings suggest that AI-supported instruction can effectively influence both understanding and behaviour. The statistical significance of these results further confirms the strong relationship between multimedia-based learning and improved outcomes. Such evidence highlights the effectiveness of multisensory and interactive learning environments in early childhood education. However, the literature also identifies limitations related to long-term developmental impact, accessibility for children with learning disabilities, and socioeconomic disparities affecting technology adoption (Hedaoo & Vali, 2015).

Augmented Reality and Multimedia Technologies for Nutrition and Sustainability

Augmented Reality (AR) and multimedia technologies enhance experiential learning by enabling interactive visualization of abstract concepts such as nutrient composition and sustainable food practices. Unlike traditional instructional methods, AR creates immersive learning environments that improve conceptual understanding and engagement. Multimedia tools—including animations, storytelling, and interactive quizzes—further support cognitive and emotional learning processes. These technologies also contribute to sustainability education by promoting awareness of food waste reduction, ecological responsibility, and healthy consumption patterns. Despite these benefits, high implementation costs, infrastructure requirements, and limited teacher training remain significant barriers to large-scale adoption (Capecchi et al., 2025).

Inclusivity, Accessibility, and Educational Equity

Inclusivity and accessibility are critical considerations in AI-based education. The reviewed literature highlights the potential of AI systems to support diverse learners through personalized instruction, adaptive content, and assistive technologies such as voice and gesture recognition. For instance, 71% of participants supported AI-based inclusive interventions, indicating strong acceptance of technology-assisted learning for children with disabilities. These systems reduce cognitive overload and accommodate different learning styles, thereby improving accessibility.

However, significant challenges remain. Educational inequality persists due to uneven access to technology, and 42% of educators reported inadequate training, limiting effective implementation. These findings suggest that without institutional investment and policy support, AI may unintentionally widen existing educational disparities (Oshinowo et al., 2025).

Sustainability and Future Directions in AI-Based Nutrition Education

Sustainability emerged as a key future-oriented theme. AI-supported systems have the potential to integrate environmental awareness with nutrition education through interactive simulations, personalized recommendations, and behavioural tracking.

However, current research is limited by short study durations and small sample sizes. Most studies focus on immediate learning outcomes rather than long-term behavioural or health impacts. These limitations highlight the need for longitudinal research, standardized evaluation methods, and larger participant groups. Future studies should also address ethical considerations, screen-time balance, and sustainable classroom integration.

Cross-Theme Analysis

A cross-theme synthesis reveals strong interconnections between personalization, gamification, cognitive development, multimedia engagement, inclusivity, and sustainability. Across all themes, consistent patterns include adaptive learning, interactive participation, behavioural reinforcement, and child-centered instructional design. The reviewed studies demonstrate measurable improvements, including increased attention, enhanced literacy and numeracy skills, and significant gains in nutritional awareness. These outcomes indicate that AI-supported interventions are more effective than traditional methods in promoting both engagement and learning. Furthermore, the literature highlights strong interdisciplinary integration between artificial intelligence, educational technology, developmental psychology, behavioural science, and nutrition science. This convergence is essential for developing holistic and effective educational systems. Overall, the findings suggest that AI-driven nutrition education is most effective when multiple approaches—such as personalization, gamification, and multimedia engagement—are combined within a unified framework. This emphasizes the importance of designing integrated, child-centered learning environments rather than relying on isolated technological solutions.

Findings and Discussion

Strengths and Limitations

The reviewed literature demonstrates several strengths in the application of Artificial Intelligence in early childhood nutrition education, particularly using innovative and interactive technologies such as adaptive learning systems, gamification, multimedia tools, and augmented reality, which significantly enhance learner engagement and participation. A key strength is the interdisciplinary integration of artificial intelligence with developmental psychology, educational technology, and nutrition science, enabling the creation of effective, child-centered learning environments. Additionally, multiple studies provide empirical evidence of positive outcomes, including improvements in nutritional awareness, cognitive development, attention span, and food-related behaviours, often supported by measurable pre- and post-intervention data. The potential for personalized and inclusive learning further highlights the adaptability of AI in addressing diverse learner needs. However, despite these strengths, several limitations are evident. Many studies rely on small sample sizes and controlled settings, limiting the generalizability of findings to real-world contexts. The short duration of most interventions restricts the assessment of long-term behavioural sustainability, while inconsistencies in evaluation methods make cross-study comparisons challenging. Furthermore, issues related to accessibility, including technological infrastructure, cost, and insufficient teacher training, pose significant barriers to implementation. There is also a lack of large-scale and longitudinal research, along with limited exploration of ethical concerns such as data privacy, screen time, and long-term psychological effects, indicating important areas for future investigation.

Table 1. Classification of AI based educational approaches in nutrition learning

Theme	**Technology used**	**Key features**	**Outcomes observed**	**Limitations**
AI-Powered Platforms	Adaptive learning systems, AI tutoring	Personalization, real time feedback, predictive analytics	Improved engagement, individualized learning, better comprehension	High cost, limited scalability, need for teacher training
Gamification	Game based learning, reward systems	Interactive challenges, motivation, feedback loops	Increased participation, improved retention, enhanced engagement	Short-term studies, small sample sizes
Cognitive & multimedia learning	Multimedia tools, AI supported instructions	Visual learning, Animations, quizzes, multisensory approach	Improved knowledge, better food behaviour, higher recall	Limited long-term evaluation
AR & Multimedia technologies	Augmented reality, interactive media	Immersive visualization and experiential learning	Better conceptual understanding, sustainability awareness	Infrastructure dependency, high implementation cost
Inclusivity and accessibility	AI adaptive systems, assistive technologies	Voice/gesture support	Improved inclusive learning, support for diverse needs	Digital divide, lack of access, insufficient training
Sustainability & future directions	AI + AR integration	Behaviour tracking, sustainability education	Awareness of sustainable diets, long-term potential	Lack of longitudinal studies, ethical concerns

The reviewed literature demonstrates that Artificial Intelligence (AI)-based educational technologies significantly improve nutrition awareness, learner engagement, cognitive development, and behavioural outcomes among children. Across the selected studies, AI-supported systems—including gamification, multimedia learning, adaptive platforms, and augmented reality—consistently produced measurable educational and behavioural improvements. The findings highlight that AI integration transforms nutrition education from passive information delivery into an interactive, personalized, and behaviour-oriented learning experience suitable for early childhood environments.

Improvement in Nutritional Knowledge and Awareness

One of the most consistent findings across the reviewed studies is the significant improvement in nutrition-related knowledge following AI-supported or multimedia-based interventions. A study involving 100 students aged 10–12 years reported that mean correct responses increased from 38.79% to 75.89%, while incorrect responses decreased from 61.21% to 24.11% after a 15-day intervention. This substantial shift indicates a marked improvement in children's comprehension and retention of nutritional concepts. Specific knowledge gains further support this trend. Balanced diet awareness improved from 45% to 72%, while understanding of ideal meal frequency increased from 3% to 65%, demonstrating enhanced foundational knowledge. Similarly, food pyramid awareness rose from 0% to 65%, and protein-related knowledge increased from 10% to 88%, indicating strong conceptual development. Awareness of the role of vitamins and minerals in preventing infections also improved significantly from 22% to 84%, reflecting improved health literacy (Hedaoo & Vali, 2015). These findings collectively demonstrate that AI-supported and multimedia-based educational approaches significantly enhance children's understanding of nutrition and healthy eating practices.

Behavioural Changes in Food Preferences

The reviewed literature also demonstrates that AI-supported interventions influence children's dietary behaviour and food preferences. Following the intervention, preference for homemade food increased from 40% to 97%, while preference for junk food decreased from 60% to 3%. This dramatic behavioural shift indicates that educational interventions can translate knowledge into practical lifestyle changes. Statistical analysis confirms a highly significant relationship between multimedia-based nutrition education and behavioural improvement. This suggests that AI-supported learning environments are effective not only in improving knowledge but also in shaping long-term dietary behaviour.

Enhancement of Cognitive Development and Learning Performance

Several studies reported measurable improvements in cognitive development and learning performance following AI-supported interventions. Results indicate a 68% improvement in cognitive development, along with a 22% increase in literacy skills and a 17% improvement in numeracy and pattern recognition abilities. These outcomes suggest that AI-supported systems enhance not only subject-specific knowledge but also overall cognitive functioning. Additionally, learner attention span increased by 19%, while 74% of respondents reported improved engagement, indicating that AI-based learning environments promote sustained focus and active participation (Oshinowo et al., 2025). These findings demonstrate that AI-supported educational tools contribute to multisensory engagement and developmental learning, which are critical during early childhood.

Increased Learner Engagement Through Gamification

Evidence from the selected articles show gamification as a highly effective approach for enhancing learner engagement and motivation. Gamified learning environments, incorporating reward systems, interactive tasks, and adaptive challenges, resulted in increased participation and improved retention of nutrition-related concepts. Observations from game-based studies indicate improved attention, reduced boredom, and enhanced emotional engagement during learning activities. This suggests that gamification is not only an engagement tool but also a mechanism for reinforcing behavioural learning through interactive feedback and reward-based motivation. However, most studies were conducted over short durations with small sample sizes, limiting the ability to assess long-term behavioural sustainability.

Improvement in Teacher Efficiency and Educational Management

AI integration also demonstrated measurable benefits for educators and classroom management. Studies reported a 31% reduction in routine assessment tasks and a 67% improvement in lesson planning efficiency, resulting in an overall 24% increase in instructional effectiveness. These improvements indicate that AI can streamline administrative tasks, allowing educators to focus more on teaching and student interaction. This highlights the dual advantage of AI in enhancing both learning outcomes and educational efficiency.

Inclusivity and Accessibility Findings

The literature highlights the potential of AI to support inclusive education through adaptive and assistive technologies. Approximately 71% of participants supported AI-assisted inclusive learning systems, particularly those incorporating voice recognition and gesture-based interaction. These technologies help accommodate diverse learning needs and reduce cognitive barriers. However, challenges remain significant. Around 42% of educators reported insufficient AI training, which limits effective classroom implementation. Additionally, unequal access to technological resources may contribute to widening educational disparities. These findings suggest that while AI has strong inclusive potential, its success depends on infrastructure, training, and policy support.

Findings Related to Augmented Reality and Multimedia Learning

Augmented Reality (AR) and multimedia technologies enhance experiential and visual learning in nutrition education. Studies indicate that AR-supported systems improve conceptual understanding by enabling interactive visualization of nutritional content. Multimedia tools, including animations, storytelling, and interactive quizzes, further enhance engagement and retention. These findings suggest that multisensory learning environments are particularly effective for young learners, as they align with developmental learning patterns and improve both cognitive and emotional engagement.

Table 2. Comparative analysis of pre – and post – intervention outcomes

Measured Outcomes	**Pre – intervention**	**Post – intervention**	**Outcome improvement**
Correct nutrition knowledge responses	38.79%	75.89%	+37.10% increase
Awareness of balanced diet	45%	72%	+27% increase
Knowledge of ideal meals per day	3%	65%	+62% increase
Food pyramid awareness	0%	65%	+65% increase
Knowledge about proteins for growth	10%	88%	+78% increase
Awareness on vitamins and minerals that prevent infections	22%	84%	+62% increase
Preference for homemade food	40%	97%	+57% increase

Preference for junk food	60%	3%	-57% decrease
Learner attention span after AI-supported learning	Traditional baseline	AI driven learning	+19% increase
Learner engagement in AI/gamified environments	Traditional instructions	Gamified AI instructions	Significantly higher participation and motivation

Overall Findings

The overall findings demonstrate that technology enhanced nutrition education systems positively influence:

- Nutritional awareness
- Cognitive development
- Learner engagement
- Behavioural reinforcement
- Food preference behaviour
- Instructional efficiency

Key measurable outcomes include:

Increase in correct responses from 38.79% to 75.89%, indicating improved knowledge. Increase in healthy food preference from 40% to 97%, reflecting behavioural change. Reduction in unhealthy food preference from 60% to 3%, showing lifestyle impact 22% improvement in literacy and 17% in numeracy, indicating cognitive benefits. 19% increase in attention span, reflecting enhanced engagement. Despite these positive outcomes, limitations such as small sample sizes, short intervention durations, lack of longitudinal evidence, and insufficient teacher training remain significant challenges.

Overall, the findings demonstrate that AI-driven nutrition education is most effective when cognitive, behavioural, and interactive learning strategies are integrated within a unified system, rather than implemented as isolated technological interventions.

Educational Implications

The study highlights the value of incorporating modern digital tools into nutrition education to create more engaging and learner-friendly classroom experiences that encourage healthy lifestyle habits from an early age.

Implications for Teachers and Educational Management

Technology-assisted instruction can support educators by simplifying classroom management, improving instructional planning, and enabling more individualized learning experiences. Effective implementation, however, depends on proper training and institutional encouragement.

Implications for Child Health and Nutrition

Interactive educational approaches can contribute to better food choices, improved health awareness, and stronger understanding of balanced dietary practices among children.

Technological and Policy Implications

Successful integration of digital learning systems requires improved infrastructure, equitable access to technology, supportive educational policies, and ethical guidelines that ensure safe and inclusive usage.

Research Implications

Further investigations are needed to examine long-term educational and behavioural outcomes, larger population groups, and the practical challenges associated with integrating emerging technologies into early childhood learning environments.

Conclusion

This review underscores the expanding role of Artificial Intelligence (AI) in enhancing nutrition education during early childhood through innovative, child-centered approaches. Technologies such as adaptive learning applications, digital games, multimedia resources, and augmented reality have demonstrated significant potential in improving children's understanding of healthy eating while making learning more engaging and enjoyable. Compared to traditional methods, AI-assisted instruction offers a flexible and personalized learning experience aligned with young learners' developmental needs.

The findings reveal that technology-enhanced education supports broader developmental outcomes by fostering curiosity, participation, concentration, and experiential learning. Interactive activities, visual materials, and personalized feedback create stimulating environments that promote both conceptual understanding and positive habit formation. The interdisciplinary integration of educational technology, behavioral science, developmental psychology, and nutrition science provides a robust foundation for designing effective learning experiences.

Despite these advantages, barriers such as limited access to digital resources, high infrastructure costs, insufficient professional training, and unequal technological availability persist. Addressing these challenges requires focused efforts on professional development, equitable infrastructure investment, and supportive policies to ensure inclusive implementation. The absence of extensive long-term studies complicates the assessment of sustained impacts on dietary behaviours and overall well-being. Ethical considerations regarding responsible technology use, data privacy, and balanced screen exposure also warrant greater attention and the development of clear guidelines. Overall, AI-integrated educational strategies can substantially strengthen early childhood nutrition education when designed inclusively, age-appropriately, and interactively. Emphasizing innovative teaching practices combined with child-centered learning principles and ethical frameworks is essential to fostering healthier lifestyles and more meaningful educational experiences during this critical developmental period.

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"Smart Technology, Strong Values", AI in Moral Education

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Abstract

AI technology progresses at a fast speed which creates new educational methods that teach value-based learning systems which help students develop their complete potential. This research investigates how artificial intelligence improves moral education through custom learning systems which use personal learning methods to develop student character development. The study uses an analytical approach to assess AI-based educational systems which adapt their content delivery to match students' cognitive development using educational materials that include storytelling and moral conflict scenarios with simulated authentic ethical dilemmas and individualized assessment systems. Research results demonstrate that artificial intelligence creates better user engagement while it helps users make responsible choices through its non-evaluative learning settings. The research shows that artificial intelligence has the ability to transform value-based educational systems, yet its effectiveness relies on how educational institutions combine new technologies with human monitoring. Educators play an essential role because they provide students with two vital components for ethical learning: emotional support and contextual knowledge.

Keywords: Artificial Intelligence (AI), Ethical Reasoning, Human Oversight, Personalized Learning, Value-based Education

Introduction

Education has undergone a significant transformation over the past few decades, driven by rapid technological advancements and the increasing integration of digital tools into the learning environment. Among these developments, artificial intelligence (AI) has emerged as a powerful force in reshaping educational practices. AI-based systems are capable of delivering personalized learning experiences, adapting content to individual needs, and enhancing student engagement. This shift has gradually moved the focus from traditional teacher-cantered approaches to more flexible, learner-cantered models of education. At the same time, moral education continues to remain a fundamental aspect of the educational process. It plays a crucial role in shaping individuals by instilling values such as honesty, empathy, responsibility, and ethical awareness. Traditionally, moral education has relied heavily on human interaction, guidance from teachers, and real-life experiences to help students understand and navigate complex ethical situations. The presence of emotional connection and contextual understanding has been considered essential in the development of moral reasoning and character formation. With the growing use of AI in education, an important question arises regarding its role in moral learning. AI systems can present ethical dilemmas, facilitate reflective thinking, and

providing a non-judgmental environment for learners to explore moral issues. These features suggest that AI has the potential to support value-based education in new and innovative ways. However, the ability of AI to replicate human judgment, emotional intelligence, and real-world contextual understanding remains limited. In this context, it becomes necessary to examine the effectiveness of artificial intelligence in moral education and to understand how it is perceived by both students and educators. While AI may enhance engagement and accessibility, the extent to which it can contribute to ethical development without human guidance is still uncertain. This study attempts to explore the role of AI in moral education by analysing user perspectives and evaluating its strengths and limitations in comparison to traditional teaching methods.

Review of Related Literature

Artificial Intelligence in Education

Artificial Intelligence (AI) has significantly influenced modern education by introducing innovative teaching and learning methods. AI-powered tools assist in content delivery, automated assessment, and personalized feedback, thereby enhancing the overall learning experience. According to recent studies, AI enables adaptive learning systems that adjust instructional content based on individual learner performance and pace. This has led to increased student engagement and improved understanding of complex subjects. Furthermore, AI has supported the expansion of online and distance learning by making educational resources more accessible and interactive.

However, despite its advantages, researchers highlight that AI cannot fully replicate the role of human educators. While AI can provide accurate information and structured guidance, it lacks the emotional intelligence and interpersonal interaction necessary for holistic development. Therefore, AI is often viewed as a supportive tool rather than a replacement for traditional teaching methods.

Moral and Value-Based Education

Moral education is a fundamental component of the educational system, focusing on the development of ethical values, character, and social responsibility among learners. It involves teaching individuals to differentiate between right and wrong and to make responsible decisions in real-life situations. Traditional approaches to moral education emphasize the role of teachers, family, and social environment in shaping an individual's value system. Scholars argue that moral development is closely linked with emotional understanding, empathy, and real-world experiences. Classroom discussions, storytelling, and role-playing activities have been widely used to enhance ethical reasoning among students. These methods rely heavily on human interaction, which allows learners to interpret moral situations within a social and emotional context.

Personalized Learning and AI

One of the most significant contributions of AI in education is the concept of personalized learning. AI systems can analyze learner behavior, identify strengths and weaknesses, and deliver customized content accordingly. This approach allows students to learn at their own pace, thereby improving comprehension and retention.

Personalized learning also encourages self-directed learning, where students take greater responsibility for their educational progress. Studies suggest that such learner-centered approaches enhance motivation and engagement. In the context of moral education, AI can present tailored ethical scenarios and reflective exercises, helping students develop their reasoning skills in a structured manner.

AI and Ethical Reasoning

AI has the potential to support ethical reasoning by presenting learners with simulated moral dilemmas and decision-making scenarios. These systems can offer multiple perspectives and logical explanations, enabling students to analyze situations critically. Additionally, AI provides a non-judgmental environment where learners can explore sensitive ethical issues without fear of criticism. Despite these advantages, the effectiveness of AI in moral reasoning remains debated. Critics argue that ethical decision-making involves not only logical analysis but also emotional and cultural understanding, which AI currently lacks. As a result, AI-based moral guidance may not fully capture the complexity of real-life ethical situations.

Limitations of AI in Moral Education

While AI offers several benefits in educational settings, it also presents certain limitations, particularly in the domain of moral education. One of the primary concerns is the absence of emotional intelligence, which is essential for understanding human values and social interactions. AI systems operate based on programmed algorithms and data, which may not always account for cultural diversity and contextual nuances. Moreover, excessive reliance on AI may reduce students' critical thinking and independent judgment. There is also a risk of students depending on AI for decision-making rather than developing their own moral reasoning abilities. Researchers emphasize that moral education requires guidance, discussion, and reflection facilitated by human educators.

Need for Human Intervention

The role of teachers remains indispensable in moral education. Educators provide emotional support, real-life context, and ethical guidance that cannot be fully replicated by AI systems. They help students interpret moral dilemmas, understand consequences, and develop empathy.

Many studies suggest that the most effective approach is the integration of AI with traditional teaching methods. In such a model, AI acts as a supplementary tool that enhances learning, while teachers continue to play a central role in guiding students' moral and ethical development. This balanced approach ensures that technological advancements are utilized without compromising the human aspects of education.

Problem Statement

The increasing integration of artificial intelligence in education raises concerns regarding its effectiveness in imparting moral values and ethical reasoning, and whether it can function as an independent tool or requires continuous human guidance.

Objectives

- To analyze the role of artificial intelligence in moral and value-based education
- To examine the impact of AI on student engagement and ethical understanding
- To study the perspectives of students and teachers regarding the use of AI in moral education
- To evaluate the effectiveness and limitations of AI in guiding moral decision-making
- To assess the importance of human intervention and emotional understanding in ethical learning

Methodology

The present study adopts a quantitative research approach to examine the role of artificial intelligence in moral education and to understand the perspectives of students and educators. The research primarily focuses on analyzing how AI influences ethical understanding, engagement, and the overall process of value-based learning.

Research Design

This study is based on a survey method, which enables the collection of structured responses from a defined group of participants. The survey approach was chosen to gather measurable data regarding the perceptions, experiences, and opinions of respondents on the use of AI in moral education. The design allows for comparison between different respondent groups, particularly students and teachers.

Primary Data

The primary data for this study was collected using two structured questionnaires, designed separately for students and teachers. The questionnaires were distributed through Google Forms, ensuring ease of access and a wider reach among respondents.

The student questionnaire focused on areas such as:

- Usage of AI tools in learning
- Impact of AI on engagement and understanding
- Role of AI in ethical and moral decision-making
- Preference between AI and human guidance

The teacher questionnaire focused on:

- Use of AI in teaching practices
- Perceptions regarding AI's effectiveness in education
- Role of AI in moral and value-based learning
- Limitations of AI and the importance of human intervention

The responses were collected from a sample consisting of students aged approximately 16–23 years and teachers with varying levels of teaching experience. The total number of respondents included both groups, allowing for a comparative analysis of perspectives.

The questionnaire included a combination of:

- Multiple-choice questions
- Likert scale questions (1–5 scale)
- Scenario-based questions
- Open-ended responses

This combination helped in collecting both quantitative and qualitative insights relevant to the research objectives.

Secondary Data

Secondary data was collected from various academic journals, research papers, articles, and online sources related to artificial intelligence in education, personalized learning, and moral or value-based education. The literature review provided a theoretical foundation for understanding the concepts and supported the interpretation of primary data findings.

Analysis

The collected data was analyzed using percentage-based analysis and graphical representation. Responses from Google Forms were compiled and interpreted using charts such as pie diagrams and bar graphs to identify patterns and trends.

Comparative analysis was carried out between student and teacher responses to highlight differences in perception regarding the role of AI in moral education. The findings were then interpreted in relation to the objectives of the study and supported by insights from the literature review.

Findings and Discussion

The present section analyzes the empirical findings derived from the primary data collected through structured questionnaires administered to both students and educators. The objective of this analysis is to examine the role of artificial intelligence in moral education by interpreting patterns in user responses and evaluating them in light of the study's research objectives.

The data has been systematically organized to reflect two key perspectives: that of students, who represent the primary beneficiaries of AI-integrated learning systems, and that of educators, who provide professional and pedagogical insight into its implementation. This dual approach allows for a comprehensive understanding of both the practical impact and the theoretical implications of AI in value-based education.

The analysis begins with the student perspective, focusing on their engagement, ethical understanding, and overall experience with AI-based learning environments. This is followed by an examination of teacher responses, which offer a critical evaluation of AI's effectiveness, limitations, and the necessity of human intervention. Together, these perspectives provide a balanced and evidence-based assessment of whether artificial intelligence can meaningfully contribute to moral education, and to what extent it should be integrated alongside traditional teaching methods.

Student Perspective on AI in Moral Education

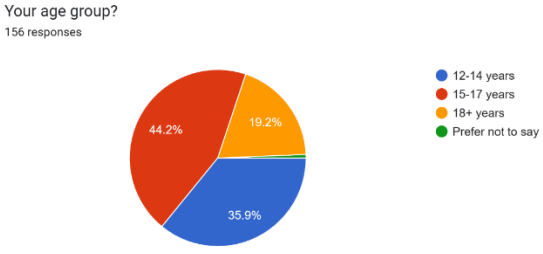
Demographic Context and AI Exposure

The student sample, comprising 156 respondents, is predominantly drawn from adolescent age groups, with 44.2% aged 15–17 years, followed by 35.9% aged 12–14 years, and 19.2% aged 18 years and above. This demographic is particularly significant, as it represents a critical phase in the development of moral reasoning and ethical awareness.

The findings further indicate a high level of familiarity with artificial intelligence tools, with 55.8% of students reporting frequent usage and 29.5% using them occasionally. This widespread exposure suggests that AI is not merely supplementary but increasingly embedded within students' everyday learning practices.

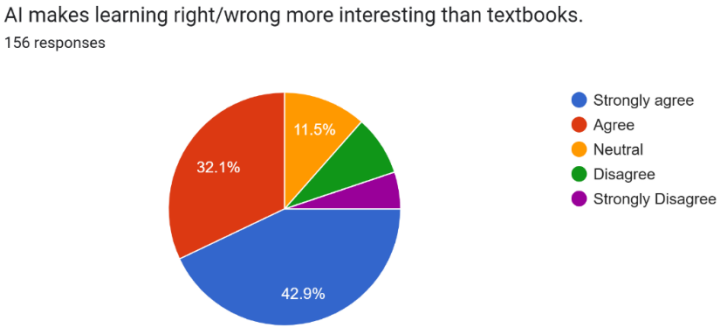
Interpretation:

The strong presence of AI in students' academic routines establishes it as a relevant and effective medium through which moral education can be explored.



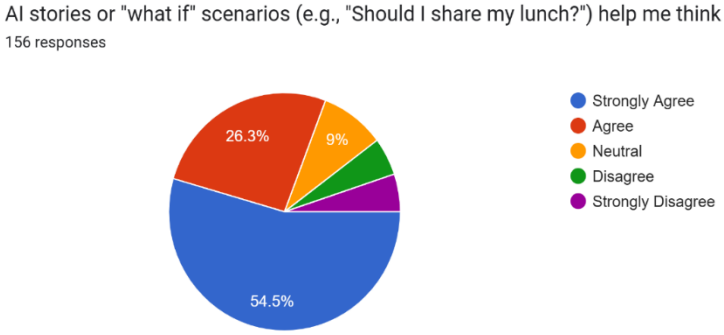
Engagement and Pedagogical Effectiveness
A key insight from the data is the role of AI in enhancing student engagement. A clear majority of respondents (42.9% strongly agree and 32.1% agree) perceive AI as making moral learning more interesting compared to traditional approaches.

Interpretation:
This suggests that AI's interactive and adaptive features contribute to transforming moral education into a more engaging and participatory process. Such engagement is particularly valuable in value-based learning, where abstract concepts often require innovative delivery methods to sustain student interest.



Ethical Reasoning through Scenario-Based Learning
The ability of AI to facilitate ethical reasoning emerges as one of its strongest contributions. A substantial proportion of students (over 80% agreement) indicated that AI-based moral scenarios and hypothetical situations help them think more deeply about ethical issues.

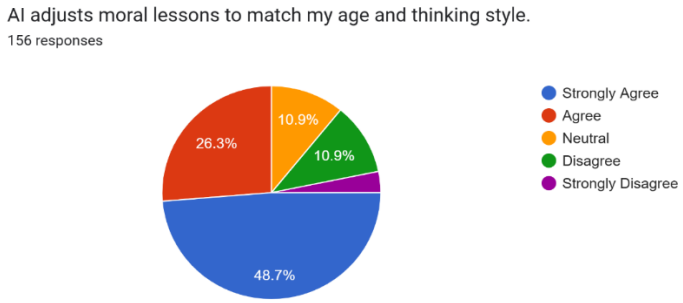
Interpretation:
This reflects a shift towards experiential learning, where students actively engage with dilemmas rather than passively receiving moral instruction. By simulating real-life contexts, AI encourages critical thinking, evaluation of consequences, and independent judgment.



Personalization and Adaptive Learning
Another important dimension highlighted by the findings is the role of AI in personalizing moral education. Approximately three-fourths of respondents (48.7% strongly agree and

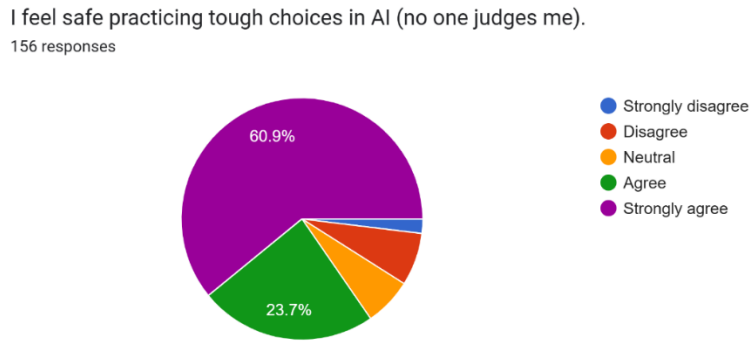
26.3% agree) acknowledged that AI adapts content according to their level of understanding.

Interpretation:
Such adaptability enhances the relevance and accessibility of moral learning, allowing students to engage with ethical concepts in a manner aligned with their cognitive development. This reinforces the potential of AI in delivering differentiated instruction.



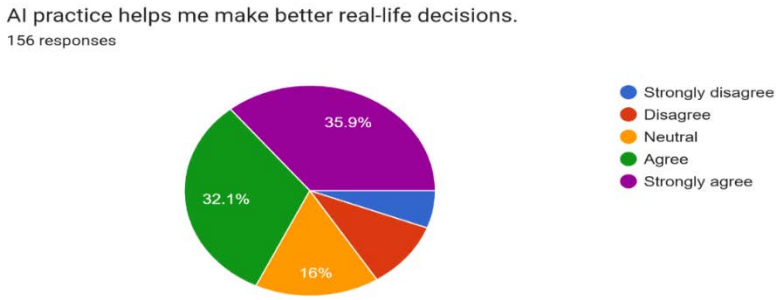
Non-Judgmental Learning Environment
A particularly significant finding is the perception of AI as a non-judgmental and safe space for ethical exploration. A strong majority of students (over 80%, including 60.9% who strongly agree) reported feeling comfortable using AI to engage with sensitive moral questions.

Interpretation:
This suggests that AI reduces the fear of criticism or evaluation, thereby encouraging more open reflection and honest engagement with ethical dilemmas. Such an environment is crucial in fostering deeper moral reasoning.



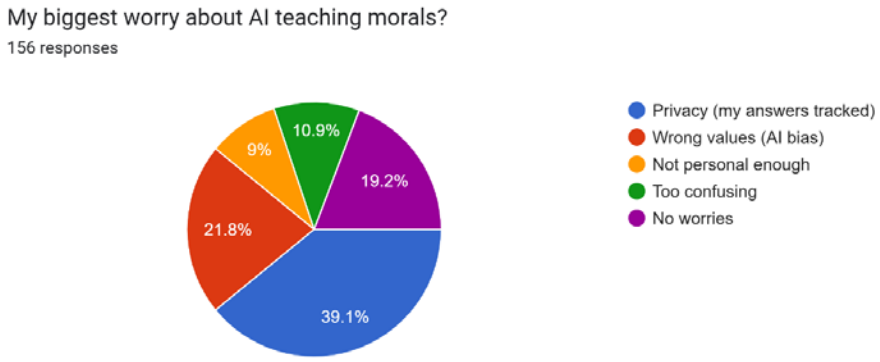
Practical Limitations in Decision-Making
Despite the overall positive perception, students exhibit a degree of caution regarding the application of AI in real-life moral decisions. While a majority (approximately 68% positive responses) believe that AI can support better decision-making, this figure is comparatively lower than other indicators.

Interpretation:
This indicates that AI is perceived primarily as a supportive cognitive tool, aiding in ethical thinking rather than serving as an authoritative guide in real-world situations.



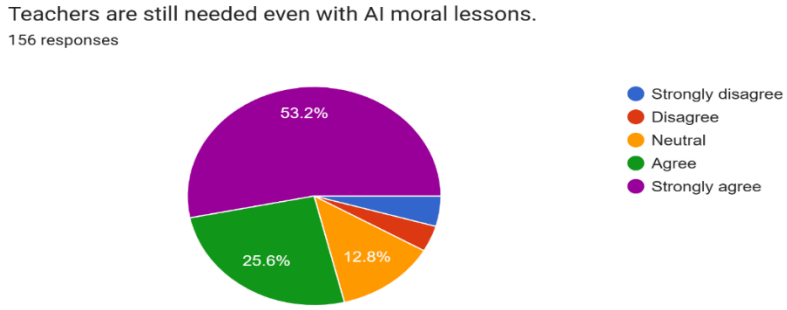
Perceived Risks and Limitations
The findings also highlight awareness among students regarding the limitations of AI. The most prominent concerns include privacy issues (39.1%) and the possibility of biased or incorrect outputs (21.8%), along with smaller concerns related to confusion and lack of clarity.

Interpretation:
These concerns reflect a growing critical awareness among students about the ethical implications of AI usage, particularly in sensitive domains such as moral education.



Continued Relevance of Human Educators
A consistent and important finding is the recognition of the role of teachers in moral education. A substantial majority (53.2% strongly agree and 25.6% agree) emphasized that human educators remain essential despite the advantages offered by AI.

Interpretation:
This highlights the perceived limitation of AI in addressing emotional, contextual, and experiential aspects of moral learning. Students acknowledge that ethical development requires human interaction, empathy, and guidance that extend beyond algorithmic reasoning.



Synthesis of Student Findings

The analysis of student responses demonstrates that artificial intelligence significantly enhances moral education by improving engagement, enabling personalized learning, and supporting ethical reasoning through interactive scenarios. At the same time, limitations related to real-world applicability, bias, and lack of emotional intelligence prevent AI from functioning as a standalone system.

Overall, the findings position AI as a complementary educational tool, capable of enriching value-based learning while remaining dependent on human guidance for deeper ethical understanding. This aligns closely with the central premise of the study and provides strong empirical support for the research objectives.

Teacher Perspective on AI in Moral Education

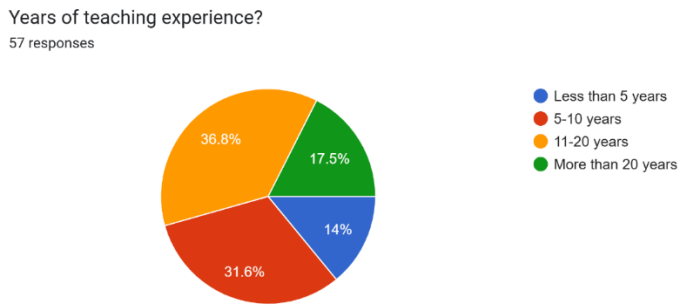
Participant Profile and AI Integration

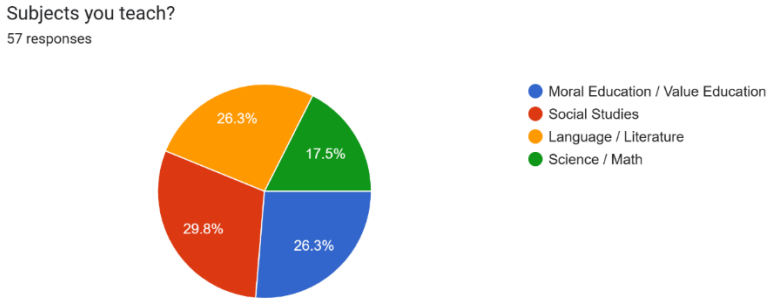
The educator sample consists of 57 respondents, with a strong representation of experienced professionals. A majority (54.3%) possess more than 10 years of teaching experience, indicating that the findings are grounded in substantial pedagogical expertise. The subject distribution is relatively balanced, with Social Studies (29.8%), Language/Literature (26.3%), and Moral/Value Education (26.3%) forming the primary disciplines.

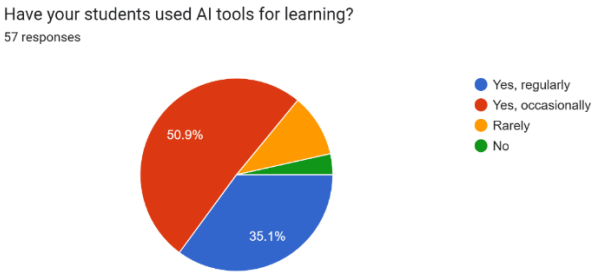
From the perspective of classroom practices, AI integration is no longer theoretical but operational. Educators report that approximately 86% of students use AI tools, with 35.1% engaging regularly and others using them occasionally.

Interpretation:

These findings confirm that AI is already embedded within contemporary educational environments, making it a relevant factor in shaping both instructional practices and student learning behaviours.







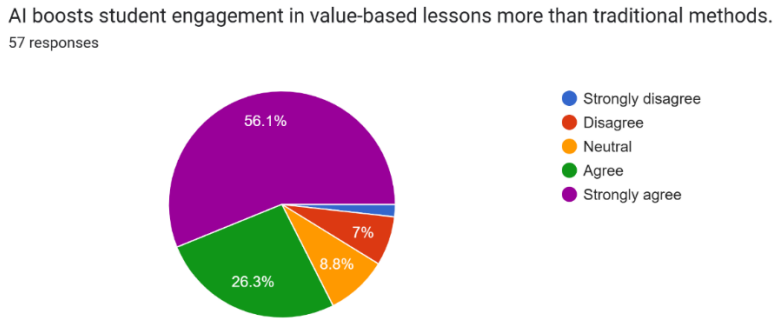
Pedagogical Effectiveness of AI in Moral Education

Educators largely recognize the pedagogical value of AI, particularly in enhancing engagement and facilitating the delivery of value-based content. A significant majority (82.4%) agree that AI tools improve student engagement in moral education compared to traditional teaching methods.

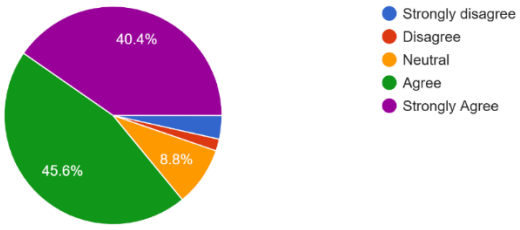
In addition to engagement, AI is perceived as highly effective in personalizing ethical learning experiences. Approximately 86% of respondents believe that AI can adapt moral dilemmas and ethical scenarios to suit varying student competency levels. This adaptability is particularly important in moral education, where learners differ in cognitive maturity and interpretive ability.

Interpretation:

These findings suggest that AI contributes to a more dynamic and inclusive learning environment by aligning instructional content with individual learner needs.



AI personalizes ethical dilemmas effectively for different student levels.
57 responses



Ethical Reasoning and Character Development

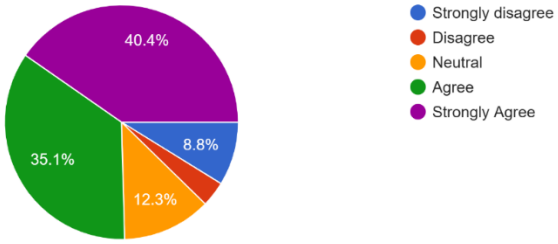
The data further indicates that AI plays a meaningful role in fostering ethical reasoning. A substantial proportion of educators (75.5%) agree that AI-driven simulations and scenario-based learning are effective in promoting character development and moral understanding.

Additionally, 79% of respondents highlight the importance of AI's non-judgmental environment in encouraging students to engage more openly with ethical dilemmas and make responsible decisions.

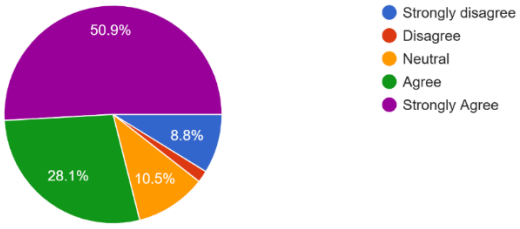
Interpretation:

AI appears to support a reflective mode of learning, where students are encouraged to explore moral issues without fear of criticism. This aligns with contemporary approaches to moral education that emphasize active participation and critical thinking.

AI simulations/scenarios build students' character and ethical reasoning.
57 responses



Non-judgmental AI environments encourage responsible decision-making.
57 responses

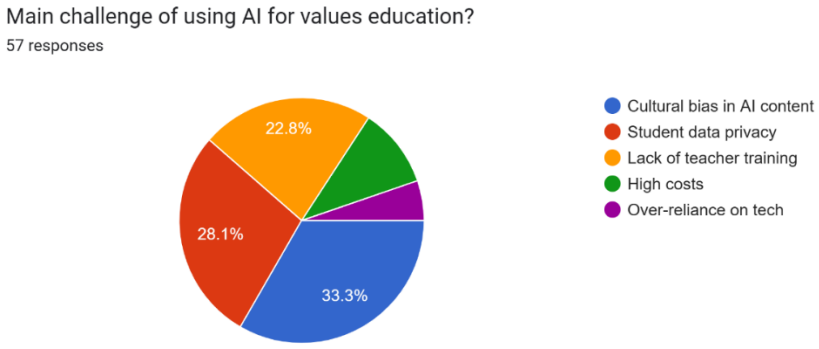


Structural Challenges and Limitations

Despite the recognized benefits, educators express significant concerns regarding the use of AI in moral education. The most prominent issue identified is cultural bias in AI-generated content (33.3%), which raises questions about the neutrality and

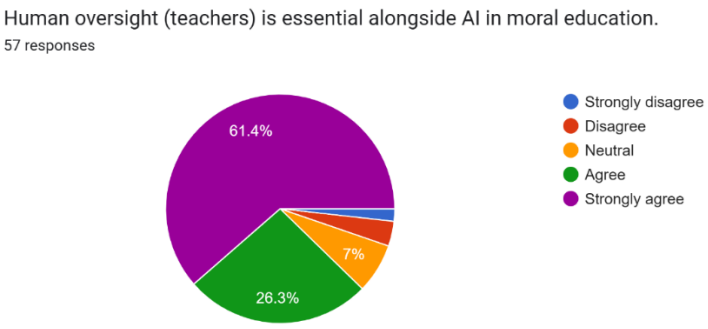
appropriateness of ethical guidance provided by such systems. Concerns regarding data privacy (28.1%) further highlight the risks associated with handling sensitive student information. Additionally, 22.8% of respondents point to a lack of adequate training and preparedness among educators to effectively integrate AI tools into teaching practices.

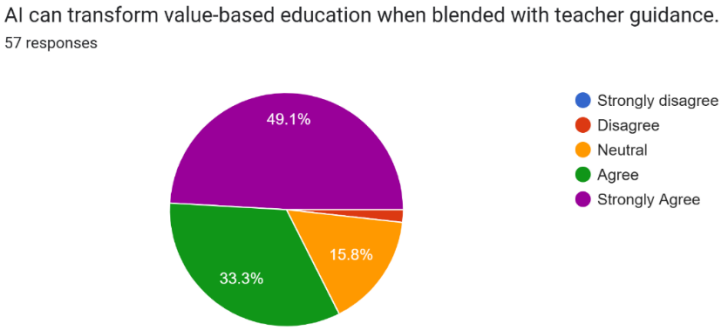
Interpretation:
These challenges underscore the structural and ethical limitations of AI, particularly in a domain as sensitive as moral education, where accuracy, fairness, and contextual relevance are critical.



Necessity of Human Oversight
A strong consensus emerges among educators regarding the indispensable role of human intervention. An overwhelming 87.7% of respondents assert that human oversight is essential when implementing AI in moral education. Furthermore, 82.4% support a blended approach, where AI is used in conjunction with traditional teaching methods.

Interpretation:
These findings clearly indicate that educators do not perceive AI as a replacement for teachers. Instead, they advocate for a "human-in-the-loop" model, where AI functions as a supportive tool while teachers provide ethical guidance, emotional context, and interpretive depth.





Synthesis of Teacher Findings

The analysis of educator responses suggests that artificial intelligence serves as a powerful pedagogical enhancer, particularly in terms of engagement, personalization, and scenario-based learning. However, concerns related to bias, data privacy, and insufficient training highlight the risks associated with its unregulated use. Overall, the findings reinforce the view that AI cannot function as an independent agent in moral education. Instead, its effectiveness is maximized within a hybrid framework, where technological capabilities are complemented by human judgment and ethical oversight. In this model, the educator continues to serve as the primary guide in shaping students' moral and ethical development.

Conclusion

The present study examined the role of artificial intelligence in moral education by analyzing empirical data from both students and educators. The findings demonstrate that AI has significant potential to enhance value-based learning by improving student engagement, enabling personalized instruction, and facilitating ethical reasoning through interactive and scenario-based approaches. Students, in particular, perceive AI as an engaging and accessible tool that allows them to explore moral dilemmas in a structured and non-judgmental environment.

At the same time, the study highlights important limitations. While AI supports the development of ethical thinking, it does not fully translate into real-life moral decision-making. Concerns related to data privacy, algorithmic bias, and lack of contextual understanding further restrict its independent application in moral education. Both students and educators strongly emphasize that moral learning extends beyond logical reasoning and requires emotional intelligence, empathy, and lived experience—dimensions that AI is currently unable to replicate.

A key outcome of the study is the clear consensus regarding the necessity of human involvement. The findings strongly support a hybrid or "human-in-the-loop" model, where AI functions as a supplementary tool while educators continue to play a central role in guiding ethical development. In this framework, AI enhances the delivery of content and supports reflective thinking, while teachers provide emotional support, contextual interpretation, and moral judgment.

Implications of the Study

The findings of this study have several important implications for educational practice and future research:

Integration of AI in Value-Based Curriculum
Educational institutions can incorporate AI tools into moral education to enhance engagement and provide personalized learning experiences. Scenario-based AI modules can be particularly effective in encouraging ethical reflection among students.

Emphasis on Blended Learning Models
The results highlight the importance of combining AI with traditional teaching methods. Schools should adopt a blended approach where AI supports instruction, but teachers remain central to the learning process.

Teacher Training and Capacity Building
The successful implementation of AI in moral education requires educators to be adequately trained. Professional development programs should focus on equipping teachers with the skills to effectively integrate AI tools into their teaching practices.

Ethical and Regulatory Considerations
Concerns regarding data privacy and algorithmic bias must be addressed through proper guidelines and ethical frameworks. Institutions should ensure that AI systems used in education are transparent, unbiased, and aligned with cultural and social values.

Scope for Future Research
Further research can explore the long-term impact of AI on moral development, as well as its effectiveness across different age groups and cultural contexts. Comparative studies involving different educational systems may also provide deeper insights.

In conclusion, artificial intelligence holds transformative potential in the domain of moral education; however, its effectiveness is contingent upon responsible implementation and continuous human oversight. Rather than replacing educators, AI should be viewed as a complementary tool that, when used thoughtfully, can strengthen the process of value-based learning.

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Future Classrooms: Integration of Artificial Intelligence in Teaching and Learning

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Abstract

In the modern era, Artificial Intelligence (AI) is transforming the education system by reshaping traditional classrooms into smart learning environments. Future classrooms are expected to integrate AI technologies such as virtual assistants, adaptive learning platforms, and automated assessment tools to enhance both teaching and learning experiences. This study explores how AI can personalize education according to the needs, pace, and interests of individual students, making learning more effective and engaging. AI-powered tools help teachers by reducing administrative workload, enabling them to focus more on creative and interactive teaching methods. At the same time, students benefit from instant feedback, customized learning paths, and improved access to knowledge. However, the integration of AI also brings challenges such as data privacy concerns, lack of digital infrastructure, and the need for proper training for educators. The findings suggest that while AI cannot replace teachers, it can act as a powerful support system to improve educational outcomes. The future classroom will be a blend of human intelligence and artificial intelligence, creating a more flexible, inclusive, and student-centred learning environment.

Keywords: Artificial Intelligence, Digital Tools, Future Classrooms, Personalized Learning, Smart Education

Introduction

Artificial Intelligence refers to the simulation of human intelligence processes by machines, particularly computer systems. These processes include learning, reasoning, problem-solving, and decision-making. In recent years, AI has gained significant attention due to its ability to analyze large amounts of data and provide intelligent solutions across various domains. In the field of education, AI is transforming traditional teaching and learning practices into modern, interactive, and personalized experiences. Educational institutions worldwide are increasingly adopting AI technologies to improve learning outcomes, enhance teaching efficiency, and provide customized learning experiences.

Organizations such as UNESCO emphasize that AI can improve access to quality education, especially in developing countries. Similarly, OECD highlights the importance of digital transformation in education systems. AI-powered tools like ChatGPT, intelligent tutoring systems, and adaptive learning platforms are widely used to support both teachers and students. These technologies enable real-time feedback, personalized learning paths, and efficient content delivery. The integration of AI into education is not

merely a technological advancement but a fundamental shift in how knowledge is delivered and acquired. This research paper aims to analyze the interactions of AI in teaching and learning, focusing on its impact, benefits, challenges, and future potential.

Review of Related Literature

The integration of AI in education has been widely studied by researchers and scholars across the globe. Several studies highlight the effectiveness of AI in improving learning outcomes and teaching efficiency.

Research indicates that AI enables personalized learning by adapting content based on student performance, preferences, and learning pace. Intelligent tutoring systems provide real-time feedback and support, helping students understand complex concepts more effectively. A study published in academic journals shows that AI applications in education include automated grading systems, learning analytics, and virtual assistants. These tools help teachers reduce administrative workload and focus more on teaching. Recent studies (2024–2026) emphasize the growing role of generative AI in education. These tools assist in content creation, lesson planning, and student assessment, making teaching more efficient and effective.

Furthermore, research highlights that AI adoption in classrooms is increasing rapidly, with educators using AI tools to enhance their teaching methods while maintaining their professional roles.

Objectives

The main objectives of this research are:
To examine the role of AI in teaching and learning
To analyze the impact of AI on educational practices
To identify the advantages and challenges of AI integration
To explore real-world applications and case studies
To suggest future developments in AI-based education

Methodology

This research adopts a qualitative approach based on:
Secondary data collection (reports, journals, articles)
Literature review
Comparative analysis (traditional vs AI learning)
Case study analysis
The data sources include reports from international organizations, academic journals, and real-world applications of AI in education. The study focuses on analyzing trends, benefits, and challenges associated with AI integration.

Analysis

AI in Teaching and Learning

Personalized Learning
One of the most significant contributions of AI in education is personalized learning. AI systems analyze student data and adapt content according to individual learning needs. This ensures that each student learns at their own pace and level.

Intelligent Tutoring Systems
AI-powered tutoring systems act as virtual teachers, providing:
Step-by-step guidance
Instant feedback
Continuous assessment
These systems help students understand complex topics and improve their academic performance.

Automated Assessment
AI automates grading and evaluation processes, reducing teacher workload. It ensures accuracy and provides detailed feedback to students.

Virtual Assistants and Chatbots
AI chatbots are available 24/7 to answer student queries and provide support. This enhances accessibility and ensures continuous learning.

AI in Educational Planning
Smart Lesson Planning
AI helps teachers create lesson plans based on:
Student performance
Learning objectives
Curriculum requirements

Predictive Analytics
AI analyzes historical data to predict:
Student performance
Dropout risks
Learning gaps
This helps educators take preventive measures.

Curriculum Development
AI supports dynamic curriculum design that adapts to technological advancements and industry demands.

Findings and Discussion
Key Findings
AI improves student engagement
Enhances learning outcomes
Reduces teacher workload
Enables efficient planning

AI enhances teaching effectiveness by providing personalized learning and real-time feedback. However, it also presents challenges such as:
Lack of infrastructure
Data privacy concerns
Over-dependence on technology
Need for technical training
A balanced approach is essential to maximize the benefits of AI while minimizing its limitations.

Recent Data (2024–2026)
Over 60% of schools are adopting AI technologies
75% of students prefer AI-based learning
80% of teachers report reduced workload
The AI education market is expected to exceed $20 billion by 2027

Case Studies
Case Study 1: BYJU'S
BYJU'S uses AI to personalize learning experiences. It tracks student progress and provides customized recommendations.
Result:
30% improvement in student performance
Increased engagement

Case Study 2: Duolingo
Duolingo uses AI to adjust difficulty levels based on user performance.
Result:
Faster learning
Higher motivation
10. Real-Time Applications
AI is widely used in:
Adaptive learning platforms
Automated grading systems
AI tutoring systems
Educational chatbots
These applications improve both teaching efficiency and learning effectiveness.

Advantages of AI
Personalized learning experience
Time-saving for teachers
Instant feedback
Improved academic performance
Data-driven decision-making

Challenges and Limitations
Ethical Issues
Data privacy concerns
Algorithmic bias

Technical Challenges
Lack of infrastructure
High implementation cost

Educational Concerns
Reduced human interaction
Over-dependence on AI.

Future Scope

The future of AI in education includes:
AI-powered smart classrooms
Integration with Virtual Reality (VR)
Advanced adaptive learning systems
Teacher training programs
Ethical AI frameworks
AI will play a crucial role in making education more accessible and inclusive.

Personal Insight (VERY IMPORTANT)

In my opinion, Artificial Intelligence is a powerful tool that can greatly improve education, but it should not replace human teachers. Teachers play an important role in guiding students emotionally, socially, and morally. AI can support learning, but human interaction is essential for overall development. Therefore, a balanced combination of AI and human teaching is the best approach for the future of education.

Conclusion

Artificial Intelligence refers to the simulation of human intelligence processes by machines, particularly computer systems. These processes include learning, reasoning, problem-solving, and decision-making. In recent years, AI has gained significant attention due to its ability to analyze large amounts of data and provide intelligent solutions across various domains. In the field of education, AI is transforming traditional teaching and learning practices into modern, interactive, and personalized experiences. Educational institutions worldwide are increasingly adopting AI technologies to improve learning outcomes, enhance teaching efficiency, and provide customized learning experiences. Organizations such as UNESCO emphasize that AI can improve access to quality education, especially in developing countries. Similarly, OECD highlights the importance of digital transformation in education systems. AI-powered tools like ChatGPT, intelligent tutoring systems, and adaptive learning platforms are widely used to support both teachers and students. These technologies enable real-time feedback, personalized learning paths, and efficient content delivery. The integration of AI into education is not merely a technological advancement but a fundamental shift in how knowledge is delivered and acquired. This research paper aims to analyze the interactions of AI in teaching and learning, focusing on its impact, benefits, challenges, and future potential.

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Artificial Intelligence–Enabled Nutrigenomics: A Transformative Approach to DNA-Based Personalized Health Education

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Abstract

The rapid advancement of Artificial Intelligence (AI) and genetic science has led to the emergence of DNA-based nutrition, a key domain within Nutrigenomics, offering new possibilities for personalized health education. This study aims to explore the role of AI-enabled nutrigenomics in transforming traditional approaches to nutrition education into more individualized and data-driven learning systems. A conceptual and exploratory approach is adopted, drawing insights from existing AI-based nutrition platforms and genetic analysis models to understand how complex biological data can be translated into meaningful dietary guidance. AI systems analyze genetic predispositions, metabolic responses, and lifestyle factors to generate personalized nutritional recommendations, moving beyond generalized dietary practices. The findings indicate that AI-driven DNA-based nutrition not only enhances individual health outcomes but also serves as an interactive educational tool, enabling learners to understand their physiological needs and make informed dietary decisions. Furthermore, it promotes preventive healthcare by identifying potential risks of lifestyle-related diseases at an early stage. The study concludes that integrating AI-enabled nutrigenomics into health education frameworks represents a significant shift towards personalized, technology-driven, and preventive learning, thereby empowering individuals with greater self-awareness and fostering sustainable dietary practices.

Keywords: Artificial Intelligence (AI), DNA-Based Nutrition, Nutrigenomics, Personalized Health Education, Preventive Healthcare

Introduction

Sustainable Big Data and Machine Learning are having their impacts on almost every aspect of life spanning from entertainment, commerce or be it healthcare. In addition, the demand for the healthcare services are increasing and many countries are struggling to provide the adequate healthcare services and are facing the shortage of healthcare practitioners. (Adam Bohr, Kaveh Memarzadeh, 2020)

It is a prominent fact that by now the Healthcare ecosystem is realizing the importance of artificial intelligence for the upcoming generations. The healthcare landscape has come to acknowledge the importance of AI-driven tools in the future of healthcare technology. An ideal mix of heightened computer processing power, expanded data collection libraries and a substantial talent pool in AI has accelerated the advancement of AI tools and technologies, including healthcare. (Adam Bohr, Kaveh Memarzadeh, 2020)

The other reason for this sudden excitement and hope around the AI and its applications is the development of Deep Learning. In comparison to the early neural networks, the deep learning (DL) possesses more than 10 layers of connections which help in finding better correlations that are too complex to be found by previous machine learning algorithms.

It is a well known fact that the AI will only be used for the purpose of Aiding in the field of healthcare and it cannot substitute the role of healthcare professionals and physicians. AI is well prepared to assist the healthcare works with numerous tasks ranging from administrative processes to clinical management and patient outreach along with specialized tasks like image analysis, medical device automation and patient monitoring. Nutrigenomics involves the application of biochemistry, physiology, nutrition, genomics, proteomics, metabolomics, transcriptomics, and epigenomics to investigate and clarify the existing reciprocal interactions between nutrients and genes at a molecular level. The identification of these interactions (gene-nutrient) will support the creation of personalized diets tailored to each person's genotype. (N. M. R. Sales, P. B. Pelegrini-2014)

One of the emerging areas influenced by AI and data-driven healthcare is Nutrigenomics, which focuses on the relationship between genes and nutrition.

Artificial intelligence (AI) is progressively reshaping nutrigenomics by facilitating customized dietary suggestions derived from genetic, metabolic, and lifestyle information. Machine learning and deep learning techniques enhance the detection of intricate gene-diet relationships, thus refining the prediction of metabolic and disease-related results. Models powered by AI facilitate the identification of biomarkers, provide dietary advice informed by genotypes, and enable real-time observation with wearable and glucose-monitoring devices, aiding in the better management of obesity, diabetes, and cardiovascular diseases. These instruments improve comprehension of personal differences in dietary reactions and facilitate precision nutrition approaches. (Janani Balamurugan, 2026)

AI-driven nutrition platforms not only support decision making regarding one’s health but also educate individuals about their personal physiological needs, healthy dietary practices, and disease prevention strategies. Therefore, there is a need to study about how AI-enabled DNA-based nutrition contributes to personalized health education, promotes preventive healthcare, and enhances awareness regarding sustainable lifestyle practices.

Review of Related Literature

Artificial Intelligence in Healthcare

The Artificial Intelligence is extremely transforming and strengthening the Modern-day Healthcare with the use of technology that can foresee, learn and perform whether it is utilized to discover new connections between the genetic sequences or to manage the surgical assistance robots. It can recognize subtle patterns that humans would entirely overlook. AI can also help to eliminate the time-consuming data handling methods by humans. It is also to be acknowledged that AI can store huge amount of data and also can produce highly accurate results. Medical AI companies also expand systems that assist the patients at every level and help them to improve the quality of their lives. The healthcare industry is in the midst of huge revolution and transformation and this is due

to the expensive medical treatments and lack of healthcare professionals in the field. Due to this, The Healthcare industry is now looking forward to implement technology-based solutions and processes to cut away the high costs and provide solutions for the rising difficulties.

AI should be a critical enabler of healthcare simplification and the development of intelligent care systems. The application of AI in the field of Healthcare include using AI for drug discovery, maternal care, patient monitoring, for clinical trials, Healthcare robotics, using AI-powered stethoscope, for data driven medicine.(Mohammed Yousef Shaheen,2021)

Prior to 2010, healthcare technology firms were concentrating on innovations offered by medical products delivering historical and evidence-based treatment. Since 2010, the emphasis has been on real-time medical platforms and care based on outcomes. Since 2020, technology has been advancing toward medical solutions that provide intelligent approaches for evidence- and outcome-driven health, emphasizing collaborative and preventive care. These smart solutions can be realized through the use of robotics, augmented and virtual reality, and AI1. In a recent survey of life science executives, 69% of life science companies have either started piloting or have implemented AI in their solutions, while 22% are assessing or intend to pilot AI solutions. The potential savings from AI in healthcare could reach $150 billion annually in the US by 2026, which should also be a significant factor in accelerating AI adoption in the healthcare sector. This acts as statistical evidence of why AI must be implemented in the field of Medicine.

AI applications in healthcare can be classified to the following domains: surgery, nursing assistant, medical consultation, administration and workflow, treatment design, cybersecurity, machine vision, automatic and preliminary diagnosis, health monitoring, medication management, and clinical trials. All these domains have applications utilizing AI in their operations.

Machine learning (ML) is a branch of artificial intelligence that offers adaptive solutions. ML can generally be divided into three distinct categories. Supervised learning algorithms create a mathematical model using a dataset that includes both the inputs and the desired outputs. In contrast, unsupervised learning algorithms work with a dataset that contains only inputs, seeking to identify patterns within the data, such as the clustering of data points. In unsupervised learning, the algorithms derive knowledge from unclassified, unlabelled, or uncategorized test data. Reinforcement learning algorithms do not rely on an explicit mathematical model for discrete time stochastic control processes. For instance, reinforcement learning is applied in scenarios like a self-driving car functioning in an environment where it receives feedback about its actions. (Keijo Haataja1, Katri Vehviläinen-Julkunen,Pekka Toivanen)

ML models are widely employed in important applications like early sepsis identification and mortality forecasting in intensive care units (ICUs). They also have an essential function in predicting heart failure and cardiovascular occurrences in cardiology, assessing cancer risk in oncology, supporting triage in emergency departments (EDs), and forecasting diabetes and hypertension in chronic disease management. These applications showcase the adaptability of ML in the medical field. Nonetheless, they also highlight issues related to domain-specific challenges and the restricted applicability of models in

various clinical environments. (Abeer Al-Nafjan ,*, Amaal Aljuhani, Arwa Alshebel, Asma Alharbi, Atheer Alshehri).

Precision medicine offers the opportunity to customize healthcare interventions for individuals or groups of patients, taking into account their disease profile, diagnostic or prognostic data, and treatment responses. This personalized treatment approach will factor in genomic variations along with other medical treatment influences such as age, gender, geography, race, family history, immune profile, metabolic profile, microbiome, and environmental vulnerabilities. The aim of precision medicine is to focus on individual biology rather than population biology throughout all phases of a patient's medical journey. This entails gathering data from individuals, including genetic information, physiological monitoring data, or EMR data, and customizing their treatment using advanced models. The benefits of precision medicine encompass lower healthcare costs, a decrease in adverse drug reactions, and improved drug efficacy. Innovations in precision medicine are anticipated to yield significant advantages for patients and transform the delivery and assessment of health services.

Automation provides effective solutions to numerous challenges faced by the healthcare industry. By automating routine administrative tasks like appointment scheduling, billing, and data entry, healthcare providers can minimize errors, enhance efficiency, and enable staff to concentrate more on patient care. Furthermore, automation in clinical procedures—such as robotic surgery, diagnostic imaging, and laboratory testing—can improve precision, decrease variability, and lead to better patient outcomes. According to Gartner, healthcare organizations that have adopted automation have experienced a 25% increase in overall efficiency. (Gokul Pandy, Vigneshwaran Jagadeesan Pugazhenthi, Jinesh Kumar Chinnathambi).

Nutrigenomics and Personalized Nutrition

The potential of genomics to improve dietary interventions is rooted in its ability to customize nutrition according to individual genetic differences. Nutrigenomics investigates the relationship between food and our genetics, studying how our unique genetic differences affect our reactions to the nutrients we consume. This area offers potential for customizing dietary recommendations to personal health requirements, likely improving health results. For example, data on genome-wide single nucleotide polymorphisms (SNPs) can help develop personalized dietary suggestions by considering an individual's genetic differences at various SNPs. Integrating genomics into nutritional sciences can improve the effectiveness of nutritional strategies. This method enables a more profound comprehension of the complex interactions between food elements and the human genome in different conditions of health and disease. This method may facilitate the development of dietary guidelines that are very predictive, minimizing the chances of unexpected results and taking into account the effects of human genetic variations. Additionally, incorporating genomic data into dietary programs has been proven to improve the precision of weight loss models, demonstrating the effectiveness of coaching that considers participants' genomic risks. This implies that genomics may contribute to implementing changes beyond general healthy eating recommendations, potentially reducing the incidence of obesity and other chronic conditions. It's essential to recognize that although nutritional genomics shows significant promise, it is still in its early stages, and further research is required to completely harness its potential in clinical settings (Saiful Singar, Ravindar Nagpal, Bahram H.arjmandi, Neda S.Akhavan).

There is strong evidence indicating that an individual's health is influenced by the interplay between their fixed genotype and nutrition (along with other environmental factors), as well as the impact of random events—a theory encapsulated in the "health pendulum" (Mathers 2002).

This phenotypic plasticity serves as the mechanistic foundation for developing lifestyle-based interventions aimed at enhancing health and well-being. So far, the majority of nutritional interventions have been broad (population-level), with few efforts made to stratify or customize these interventions. Such customization could be realized by considering each person's dietary, phenotypic, or genotypic traits. (Ulf Görman, John C. Mathers, Keith A. Grimaldi, Jennie Ahlgren & Karin Nordström)

Nutrition disorders, including obesity, cardiovascular disease, and diabetes, are primarily caused by unhealthy diets and/or lifestyles, making them the leading cause of premature deaths globally (1). Following dietary guidelines, which recommend specific nutrient intakes, is essential for maintaining health at the population level (2). However, this universal approach fails to account for individual differences, which arise from diverse responses to nutrients due to varying genetic predispositions, metabolic phenotypes, and microbial compositions. Consequently, personalized nutrition, tailored to individual requirements, has been suggested as a solution to this issue.

The terms "personalized" or "precision" have gained prominence since the launch of the Precision Medicine Initiative in the United States in 2015. Much like precision medicine, personalized nutrition involves utilizing unique information about an individual to customize nutritional interventions, including advice, products, and services, to help them achieve better health outcomes compared to those obtained through generic, population-based methods. With advancements in “omics,” such as genomics, transcriptomics, proteomics, metabolomics, microbiome studies, and data technology, personalized nutrition is gradually becoming a reality. Among these, genomics has progressed into the post-genomic era, and genomic data is increasingly being used to customize personalized nutrition for specific nutritional supplements, leading to the interdisciplinary field known as nutrigenetics. The International Society of Nutrigenetics/Nutrigenomics (ISNN) suggests that the future of personalized nutrition should encompass three levels: “conventional nutrition based on general guidelines for population groups by age, gender, and social determinants; individualized nutrition that incorporates phenotypic information about individuals' current nutritional status; and genotype-directed nutrition based on rare or common gene variations.

The human genome includes 3–10 million genetic variations, primarily consisting of single nucleotide polymorphisms, along with insertion/deletion polymorphisms and short tandem repeat polymorphisms (Ku, Loy, Salim, Pawitan, & Chia, 2010). Nutrigenetics is frequently linked to tailored nutrition, and the notion that every human genotype corresponds to a particular diet is increasingly popular among the public. (Guy Vergères,2013)

AI-Based Nutrition Platforms

Health is crucial for overall wellbeing and productivity, and innovative solutions like customized nutrition applications are needed to appropriately address nutritional needs and prevent lifestyle-related diseases. Artificial intelligence (AI)-powered nutrition apps offer personalized health and nutrition solutions. These apps combine advanced

algorithms, data-driven insights, and user-centric design to monitor health metrics, physical activity, and food intake. AI encourages consumer participation through chatbots, voice assistants, and gamification. These systems can help avoid obesity, malnutrition, and chronic diseases in addition to promoting preventative healthcare. Nevertheless, there are still challenges including algorithmic bias, data privacy, legal issues, and nutrition database validation. Collaboration between AI developers, dietitians, and medical experts is crucial for accurate and reliable responses.(Gajendra Prasad, Mrutyunjay Padhiary, Azmirul Hoque, Kundan Kumar-2025)

DNAfit-Company

Over time, DNA testing has grown in popularity, with DNAfit being one of the most well-known providers. DNA testing purports to evaluate your genetic composition, giving customers access to information about their fitness and health that they would not otherwise have. The business can then utilize this data to create a special exercise and nutrition plan that is tailored to your body.

What is DNAfit?

It was found by Avi Lasarow in 2013 to make the common people to understand how their genes affect their health and fitness. It is a London-Based company which is a direct to consumer genetic testing company that provides DNA-Based insights into diet, health and fitness. This can be used by anyone- Students, Common people, to understand more about themselves.

Some of the most thorough DNA testing is allegedly offered by DNAfit. Additionally, the business claims that it can offer unparalleled insight into users' well-being, exercise, nutrition, and diet. However, there is little scientific backing for DNA-based customization, and some of their health claims are unfounded.

This company offers three main products, they are:

1. Diet Fit
2. Health fit
3. Circle premium

Each of these kits provide people with all the necessary tools to collect the DNA sample at home and after that, the sample would be sent to state-of-the-art laboratory for analysis. Once the results are ready, the concerned person would receive a personalized report with actionable insights and appropriate suggestions based on one’s unique genetic makeup.

What do DNA fit test results conclude?

The ultimate goal of this test is to provide with information that can be used to improve one’s health and fitness.

As mentioned earlier, the company offers three different tests with three different focus:

1. Diet Fit focuses on genes and information related to weight loss, metabolism, and nutrition.
2. Health Fit also focuses on genes related to diet and nutrition and particularly assess full body factors like stress, sleep and diet.
3. Circle premium is considered to be the most comprehensive option which focuses on diet, health, fitness and ancestry.

How to interpret results

When one receives the DNAfit reports, the person must remember that it is only one part of the picture. The results must be used as a guide rather than believing it certainly.

If the report mentions that a person has a higher risk for developing type 2 diabetes, It doesn't mean that the person would definitely develop one in the future likewise if a lower risk doesn't necessarily mean that the condition would not occur.

Hence, It is really important to understand that not only DNA is a factor but there are many other factors that needs to be considered like- Lifestyle choices, Environment and Food choices and many more.

DNA fit products and services

PRODUCT	**PRICE**	**WHAT YOU GET**	**RESULTS TURNAROUND**
Diet Fit	$151	11 diet insights 13 nutrient insights Personalized meal plans	10-15 business days
Health Fit	$199	11 diet insights 13 nutrient insights 11 fitness insights 5 stress and sleep insights Personalized meal plans Training Plans	10-15 business days
Circle Premium	$629	15 diet insights 20 nutrient insights 18 sports and fitness insights 8 stress and sleep insights 7 well-being reports Health reports including cancer, Dementia, and 65 others Ancestry report Health coach consultation Genetic counsellor consultation	Around 18 business days

(Reference from healthline.com)

ZOE Limited
This is a yet another personalized nutrition program app to provide people with personalized health insights using various data that is collected.

About the App:
This app was developed by collaboration between Zoe, king's college London, Guy's and St Thomas' hospitals with the help of funding which was granted by the government of UK. This app was created in response to the COVID-19 pandemic, and the purpose of this app is to track the symptoms of COVID-19.

Now, In US and UK, the Zoe limited also provide a separate product, A "Personalized nutrition program" where the company supplies sensors to quantify a person's gut microbiome, blood fat and blood sugar responses to various food intakes alongside which another app uses these data to provide suggestions on Dietary modifications. (Wikipedia.com)

Key features and Benefits
- AI Food Scanner and Scoring: Scan barcodes or snap photos of meals to get quick feedback on how healthy they are, based on Zoe's, proprietary database.
- Processed food risk scale: It inspects the quality of the processed foods and provides people with better and healthier options with lower health risk.
- Personalized Nutrition: Provides tailored suggestions to improve energy, mood, sleep, and gut health by suggesting healthier food options
- Habit tracking: Tracks daily progress and food quality rather than just focusing on weight and calories.

How does this app work?
- Bundle: one can buy a gut test kit and a 12-month app subscription for approximately $268.88.
- App only: A 12-month subscription is around $9.99 per month or a 3-month subscription for $24.99 per month.

Other Wearable Devices
Wearable devices integrated with AI-based nutrition apps like fitbit, Apple watch and specializes sensors) provide real time, personalized dietary suggestions by continuously tracking and monitoring activities of the body, blood glucose and hydration. These tools make use of AI to offer quick suggestions, Tailored insights based on One's health conditions, reducing manual interference and boosting behavioral adherence to healthier habits.

Examples of Various Wearable Devices
- Continuous glucose monitors (CGMs): These provide real-time interstitial glucose readings, which allows AI to analyse how a particular food intake affects a person's blood sugar levels. This allows them to be more cautious and make essential dietary adjustments.
- AI cameras and wearable sensors: Specialized devices such as camera enabled pendants (example: The Drop), They identify and analyse the meals and provide useful insights on nutritional intake (calories, protein, fat).

- Advanced biosensors: They are used to monitor nutrient levels, such as vitamins, by analysing a person's sweat, which offers extremely useful insights on one's diet.
- Smartwatches (fitbit, Apple watch): These are used for tracking one's daily activity, energy expenditure and heart rate. The combination of these with food intake data helps AI to provide a comprehensive view of energy balance. (google.com)

Advantages of Wearable and AI Integration

- Automated tracking: reduces error which can occur due to manual interference and provide accurate conclusions by using image-based dietary assessment and passive data collection.
- Provides real time feedbacks: AI helps in recommending appropriate solutions instantly
- For example: Suggests quick walk after a high-glucose meal.
- Personalized insights: The algorithms identify a connection between food intake, physical activity and metabolic responses to offer personalized nutritional plans rather than providing a common advice.

Current Challenges:

- Privacy concerns: while the AI capture images of meals, it can also capture the image of surrounding people and environment.
- Accuracy: The AI estimation of food quantities from photos require high precision to match the level of a nutritionist's tracking. (google.com)

Recommendation Systems in Nutrition

Nutrition is the essential basis for health and development of human life from the earliest stage of fetal development till the old age. Though most people are aware about the significance of healthy eating habits for health, they tend to ignore it most of the time due to their urban lifestyle and unwillingness.

The Nutrition recommendation systems are one of the main technologies applied in nutrition informatics scope. They are often considered as an effective tool in order to support users for modifying their eating behavior and reaching the goal of healthier food choices. (pubmed central)

The recommendation system is considered as a effective approach in order to aid users to adjust their eating behavior and achieve the goal of healthier food and diet. The capacity of these systems depend on technical requirements and proper design based on system types and functionality. There are various techniques which has bee used to create a individualized recommendations, the various techniques used are:

- Collaborative filtering recommender systems (CF)
- Content based recommender systems (CB)
- Knowledge based recommender systems (KBS)
- Hybrid recommender systems (HRS)

Despite the various application of recommendation systems in many fields, there is not much evidence in using recommendation systems in health informatics or medicine.

The mostly used recommender systems in nutrition recommendation systems is Hybrid recommendation systems.

Objectives

Artificial Intelligence (AI) has emerged as an important technological advancement in the field of healthcare, nutrition, and education. Nutrigenomics, which studies the interaction between genes and nutrition, has gained significant attention due to its role in personalized nutrition and disease prevention. The integration of AI into nutrigenomics education helps in improving learning efficiency, analyzing large genetic datasets, and providing personalized dietary recommendations. Therefore, this study aims to examine the importance and applications of AI in nutrigenomics education.

The major objectives of this study are:

- To understand the concept of Artificial Intelligence and nutrigenomics and their relationship in modern healthcare and education.
- To study the role of AI technologies in enhancing nutrigenomics education and personalized nutrition learning.
- To analyze how AI assists in interpreting genetic and nutritional data for educational and research purposes.
- To identify the advantages of integrating AI in nutrigenomics, including improved accuracy, efficiency, and personalized learning experiences.
- To examine the challenges and limitations associated with the use of AI in nutrigenomics education, such as ethical concerns, privacy issues, and lack of awareness.
- To explore recent developments and future opportunities of AI applications in nutrigenomics research and education.
- To evaluate the impact of AI-driven tools and technologies on healthcare professionals, students, researchers, and nutrition educators.

Through these objectives, the study attempts to provide a comprehensive understanding of the growing importance of AI in nutrigenomics education and its future potential in healthcare and nutrition sciences.

Methodology

The present study is mainly based on secondary sources of data. Information related to Artificial Intelligence and nutrigenomics education was collected from various reliable and authentic academic sources. The study follows a descriptive and analytical research approach to understand the role, applications, benefits, and challenges of AI in nutrigenomics education.

The data for the study were collected from:

- Research articles
- Scientific journals
- Review papers
- Online academic databases

Trusted websites related to healthcare, nutrition, genetics, and Artificial Intelligence and research.

Relevant literature published in recent years was selected to ensure updated and accurate information regarding advancements in AI and nutrigenomics. Various studies focusing

on personalized nutrition, genetic analysis, machine learning, educational technologies, and AI-based healthcare systems were carefully reviewed and analyzed.

The collected information was systematically organized under different themes such as:

- Concept of Artificial Intelligence
- Basics of nutrigenomics
- AI applications in nutrigenomics education
- Personalized nutrition and genetic analysis
- Benefits of AI integration
- Challenges and ethical concerns
- Future scope and technological developments

The study mainly focuses qualitative analysis of existing literature and findings from previous research works. Comparative analysis was also carried out to understand the similarities and differences among various studies related to AI applications in nutrigenomics.

According to recent studies, this methodology helped in obtaining a broad understanding of the subject and identifying the current trends, opportunities, and limitations in the field of AI-driven nutrigenomics education. The study also aims to provide useful insights for students, researchers, educators, and healthcare professionals interested in the future development of personalized nutrition and AI technologies.

Analysis

Artificial Intelligence (AI) has significantly made a revolution in the healthcare and education sectors in recent years. One of the emerging interdisciplinary fields benefiting from AI is nutrigenomics. Nutrigenomics focuses on understanding the relationship between genes, nutrition, and health. The integration of AI into nutrigenomics education has improved the efficiency of data analysis, personalized learning, and nutritional recommendations. This section analyzes and discusses the major applications, benefits, challenges, and future implications of AI in nutrigenomics education.

AI and Nutrigenomics Integration

AI technologies such as machine learning, deep learning, and predictive analytics play an important role in analyzing large amounts of genetic and nutritional data. Nutrigenomics involves complex information regarding gene expression, dietary patterns, metabolism, and disease risks. Traditional methods of analyzing such data are often time-consuming and difficult. AI helps simplify this process by identifying patterns, predicting outcomes, and generating accurate interpretations.

In educational settings, AI-based tools support students and researchers in understanding genetic interactions and nutritional responses more effectively. Interactive learning platforms, virtual simulations, and AI-assisted educational software enhance the learning experience by providing personalized content and real-time feedback.

Role of AI in Personalized Nutrition

One of the major contributions of AI in nutrigenomics is personalized nutrition. AI systems can analyze an individual's genetic profile, lifestyle habits, and dietary intake to

provide customized nutritional recommendations. This helps in preventing diseases and promoting better health outcomes.

For example, individuals with specific genetic variations may respond differently to certain nutrients. AI can identify these variations and suggest suitable dietary modifications. Such personalized and tailored approaches improve the effectiveness of nutrition planning and increase awareness towards preventive healthcare.

In educational aspects, personalized learning methods powered by AI help students understand the practical applications of nutrigenomics in clinical and healthcare settings.

Benefits of AI in Nutrigenomics Education

The integration of AI in nutrigenomics education offers several advantages:

Improved Data Analysis

AI can process large and complex datasets quickly and accurately. This helps students and researchers interpret genetic and nutritional information more efficiently.

Personalized Learning Experience

AI-based educational platforms can adapt learning materials according to the learner's needs, abilities, and progress. This improves understanding and engagement.

Enhanced Research Opportunities

AI supports advanced research in genetics, nutrition, and disease prevention. Researchers can identify patterns and relationships that may not be easily detected through manual analysis.

Better Healthcare Applications

AI-driven nutrigenomics contributes to precision medicine and personalized healthcare. It enables healthcare professionals to provide more targeted dietary interventions.

Time and Cost Efficiency

Automation of data analysis reduces manual workload, saves time, and improves research productivity.

Challenges and Ethical Concerns

Despite its advantages, the use of AI in nutrigenomics education also poses several challenges. They are:

1. **Privacy and Data Security**

Genetic information is highly sensitive. Improper handling of such data may lead to privacy violations and misuse of personal information.

2. **Lack of Awareness and Technical Knowledge**

Many students, educators, and healthcare professionals may lack sufficient knowledge about AI technologies and their applications in nutrigenomics.

3. **Ethical Issues**

Ethical concerns related to genetic discrimination, informed consent, and bias in AI algorithms remain important challenges.

4. **High Cost and Infrastructure Requirements**

Implementation of AI technologies requires advanced infrastructure, software, and technical expertise, which may not be available in all educational institutions.

5. **Dependence on Technology**
Excessive dependence on AI systems may reduce human involvement and critical thinking in healthcare and education.

Future Scope of AI in Nutrigenomics Education
The future of AI in nutrigenomics education appears highly promising. Rapid advancements in machine learning, genomics, and digital healthcare are expected to improve personalized nutrition and precision medicine further. AI-powered educational tools may provide more interactive and practical learning experiences for students and researchers.

- Future developments may include:
- AI-driven virtual laboratories
- Advanced genetic prediction systems
- Real-time dietary monitoring applications
- Smart healthcare technologies
- Improved personalized nutrition platforms

With continuous technological growth, AI is expected to become an essential component of nutrigenomics education, research, and healthcare practice.

Findings and Discussion

The analysis shows that AI has the potential to revolutionize nutrigenomics education by improving data interpretation, personalized learning, and healthcare applications. AI technologies help simplify complex genetic information and support efficient nutritional analysis. However, challenges related to ethics, privacy, infrastructure, and awareness must be addressed for effective implementation. Overall, the integration of AI into nutrigenomics education creates new opportunities for students, researchers, healthcare professionals, and educators. Proper training, ethical regulations, and technological accessibility are necessary to maximize the benefits of AI while minimizing its limitations.

The present study highlights the growing importance of Artificial Intelligence (AI) in the field of nutrigenomics education and personalized nutrition. From the analysis of various research articles, journals, and review papers, several important findings were identified regarding the applications, benefits, and future scope of AI in nutrigenomics.

One of the major findings of the study is that AI plays a significant role in analyzing complex genetic and nutritional data. Nutrigenomics involves understanding how nutrients interact with genes and influence human health. Since large amounts of genetic information are difficult to analyze manually, AI technologies such as machine learning and predictive analytics help in processing data quickly and accurately.

The study also found that AI contributes greatly to personalized nutrition. AI systems can evaluate an individual’s genetic profile, dietary habits, and lifestyle factors to provide customized nutritional recommendations. This helps in disease prevention, health improvement, and better dietary management.

Another important finding is that AI improves nutrigenomics education by providing interactive and personalized learning experiences. AI-powered educational tools, virtual simulations, and digital learning platforms help students and researchers understand complex genetic concepts more effectively. These technologies also improve research efficiency and knowledge accessibility.

The study further reveals that AI has strong potential in advancing precision medicine and healthcare. By integrating genetic information with nutritional science, AI helps healthcare professionals develop targeted dietary interventions for patients. This supports preventive healthcare approaches and improves treatment outcomes.

In addition, the study found that AI can reduce the time and effort required for research and data interpretation. Automation of data analysis improves productivity and allows researchers to focus on innovation and scientific development. Overall, the findings indicate that AI has become an important technological tool in nutrigenomics education, research, and healthcare applications. Its ability to improve accuracy, efficiency, and personalized learning makes it highly valuable for future advancements in nutrition science.

Challenges

Despite the numerous benefits of AI in nutrigenomics education, several challenges and limitations were identified during the study.

One of the major challenges is the issue of privacy and data security. Nutrigenomics involves sensitive genetic and health-related information. Improper handling or unauthorized access to such data may lead to privacy violations and misuse of personal information.

Another challenge is the lack of awareness and technical knowledge among students, educators, and healthcare professionals. Many individuals may not possess sufficient understanding of AI technologies and their practical applications in nutrigenomics. This can limit the effective implementation of AI-based systems.

The study also identified ethical concerns related to the use of AI in genetics and healthcare. Issues such as genetic discrimination, bias in AI algorithms, and informed consent remain important concerns that require proper regulation and ethical guidelines.
High implementation cost is another significant challenge. AI technologies require advanced software, infrastructure, internet facilities, and technical expertise. Educational institutions and healthcare organizations with limited resources may face difficulties in adopting such technologies.

In addition, dependence on technology may reduce human interaction and critical thinking in education and healthcare practices. Excessive reliance on AI systems could affect independent decision-making abilities among learners and professionals.

Limited availability of quality genetic databases and standardized information also acts as a barrier in AI-driven nutrigenomics research. Inaccurate or incomplete data can affect the reliability of AI predictions and nutritional recommendations.

Therefore, while AI offers enormous opportunities in nutrigenomics education, addressing these challenges is essential for its successful and ethical implementation. Proper training, awareness programs, ethical regulations, and improved technological accessibility are necessary to maximize the benefits of AI in the future.

Conclusion

Artificial Intelligence (AI) has emerged as a transformative technology in the fields of healthcare, nutrition, and education. The present study highlights the significant role of AI in nutrigenomics education and its contribution to personalized nutrition and precision healthcare. Nutrigenomics, which focuses on the interaction between genes and nutrition, requires the analysis of complex genetic and dietary information. AI technologies help simplify this process through efficient data analysis, predictive modeling, and personalized recommendations. The study shows that AI improves nutrigenomics education by enhancing learning experiences, supporting research activities, and increasing the accuracy of nutritional analysis. AI-powered tools and digital platforms enable students, researchers, and healthcare professionals to better understand genetic interactions and individualized nutrition planning. Personalized nutrition supported by AI also contributes to disease prevention, health promotion, and improved healthcare outcomes.

At the same time, the study identifies several challenges associated with the implementation of AI in nutrigenomics education. Issues related to privacy, ethical concerns, lack of awareness, high implementation costs, and dependence on technology remain important limitations. These challenges indicate the need for proper regulations, technical training, and responsible use of AI systems. Despite these limitations, the future scope of AI in nutrigenomics education appears highly promising. Continuous advancements in machine learning, genomics, and digital healthcare are expected to improve personalized nutrition and educational practices further. AI has the potential to become an essential component in modern nutrition science, research, and healthcare management.

In conclusion, the integration of Artificial Intelligence into nutrigenomics education provides new opportunities for innovation, research, and personalized healthcare. With appropriate ethical guidelines, awareness, and technological support, AI can play a vital role in shaping the future of nutrition and health sciences.

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Is There a Teacher in Class?
AI Assistance and Changing Pedagogy

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Abstract

There is an immeasurable integration of AI into diverse aspects of human ventures. The domain of Education is one in which AI is challenging as well as supporting the undertakings of both teachers and students. The conventional teacher-centric approach is being replaced by blended educational platforms. Amidst AI's high quality automation and enhanced accuracy, there exists a growing concern about human agency. In this context, the various debates on the question of the relevance and importance of teachers are not uncommon in the world of academia. The objective of this study is to analyse the evolving roles of teachers in HE institutions as facilitators and mentors in nurturing holistic learner development - academic, emotional, social, and ethical - within an increasing technology-integrated academic framework of AI tools and multimodal systems. This study adopts a qualitative and explanatory research design to examine the key themes like AI-enabled teaching-learning, pedagogical reforms, changing roles of educators and the Human-AI synergy. It is conceptual and focusses on critically evaluating the secondary sources, including academic articles, books, policy documents, reports on artificial intelligence in education, and the consultation of online resources. Besides considering appropriate pedagogical frameworks, the theoretical insights related to Constructivism and Transhumanism are also included in the discussion. There is a strong concluding remark on the success of adopting hybrid teaching-learning atmosphere, where teachers primarily impart value-based holistic education.

Keywords: AI, Constructivism, Human-AI Synergy, Transhumanism, Teacher Roles

Introduction

There is an immeasurable integration of AI into diverse aspects of human ventures. The domain of Education is one in which the proliferation of AI tools has totally transformed the teaching – learning scenario across the globe. With relentless force, AI is challenging as well as facilitating the endeavours of both teachers and students. It is reforming pedagogy patterns by Personalized System of Instruction (PSI) and questions the authority of Factory-model education and rote learning.

AI is highly teacher-friendly as it has automated many of teachers' tasks and created quality time for the teachers to focus on their teaching mission. Hence the clerical task of administrative workload, manual attendance maintenance and student assessment do not pose a threat to the teachers' prep schedule. Dr. Biji Kumar (2025) documented that the "Indian School Management System (ISMS), developed by a Pune-based start-up, uses AI to optimise various administrative functions across 850+schools. The system automatically

generates optimal timetables considering teacher availability, subject requirements, and classroom constraints. It also uses facial recognition for attendance tracking and predictive analytics for resource allocation" (p.19).

On the other hand, the prudent integration of various AI tools and platforms into conventional teaching methodology has emboldened the teaching community to embrace dynamic instructional approaches. To mention a few examples, Eduaide.ai is a teacher-friendly designer of lesson plans and generator of instructional materials without compromising on the required standards of the curriculum. Curipod produces interactive lessons that involve student contribution. Quizizz is an AI-powered quiz-builder whereas ChatGPT and Gemini are versatile generative AI Chatbots that provide round the clock service for planning, automated support and individual assistance.

Amidst AI's high quality automation and enhanced accuracy, there is growing apprehension that a teacher's role will be threatened, feasibly leading to a kind of digital monopoly. But the underlying speculation is that "AI isn't here to replace teachers. It's here to support them enhancing professional judgment while educators bring creativity, empathy, and ethics to the classroom" (McGriff, 2025, Demystifying AI, para. 2).

Review of Related Literature

The overwhelming interference of the composite network of AI systems and tools into our learning framework has drastically automated the teachers' workspace and personalized learning patterns by fostering learner-centric pedagogy. Hence the conventional teacher–student relationship, which rested on a hierarchical structure with the teacher as the fountainhead of knowledge and the student as a compliant 'receiver', is being dismantled in contemporary educational contexts. In the present scenario of techno-enhanced teaching-learning systems, the teacher-student relationship is therefore reconfigured into a collaborative and mutually complementing system that demands the intellectual and creative engagements of both. There is an essential need to resolve the conflict between automation and human agency.

A survey of the existing research perspectives shows that the Intelligent Tutoring Systems that evolved as Computer-assisted instruction combined Artificial Intelligence with the educational objectives in order to revolutionize the sphere of education. Seymour Papert, a pioneer of AI and Constructionist movement in education, explored technology-engaged learning, and emphasized the influence of Play (or Game) in the cognitive development of children. Papert advocated the sensible use of technological instruments that expedite innovative thinking. This learner-centric approach transformed learners from passive receivers of knowledge into innovative thinkers. Neil Selwyn, Professor and researcher, did extensive research work on the need to integrate Digital media into learning at schools and universities. Over three decades, Selwyn has critically explored the vital areas including AI, automation and data-driven modes that redefine the landscape of education.

Wayne Holmes, scholar in AIED, claimed the dynamism of AI in amplifying teaching through efficient automation, and motivated the educators to engage in much advanced pedagogical practices. In the same way, Rosemary Luckin, Professor of Learner Centred Design at the UCL Knowledge Lab, University College London, emphasized the harmonizing impact of Human Intelligence and Artificial Intelligence. Melanie Mitchell, neither blatantly optimistic nor dismissive, discussed genuine concerns about the limitations

of AI. She observed that even the sophisticated AI technologies lack deep human understanding and resourcefulness that define human intelligence.

Much of the existing literature survey focusses on the judicial introduction of AI tools into education, while the recent researchers and academicians discuss the dangers of profuse integration of AI and its ensuing tensions about adhering to research ethics and academic integrity. Considering the available scholarship, the study aims to explore the importance of AI assistance in transforming pedagogic roles and responsibilities within the technology-enabled educational setup. With digitised classrooms and AI emerging as co-teachers and instructors, the study strongly addresses the sparsely discussed research gap concerning the teacher assuming the role of ethical guide and mentor.

Research Questions

RQ1) What roles do teachers undertake in AI-enabled classroom?

RQ2) How is pedagogy progressing with the integration of AI?

RQ3) How do teachers maintain engagement and agency in AI-enabled classroom?

RQ4) How can academic honesty and research integrity be maintained?

Thesis Statement
The objective of this study is to explore the crucial role of teachers as facilitators in nurturing holistic learner development - academic, emotional, social, and ethical - within a rising technology-integrated academic framework of AI tools and multimodal systems

Methodology

This study adopts a qualitative and explanatory research design to examine the key themes like AI-enabled teaching-learning, pedagogical reforms, changing roles of educators and the Human-AI synergy. It is conceptual and focusses on critically evaluating the accessible scholarly opinions on AI and pedagogy.

The research is based on secondary sources, including academic articles, books, policy documents, reports on artificial intelligence in education, and the consultation of online resources. The analysis aims to combine diverse perspectives instead of quantifying the findings based on data collection.

The study incorporates appropriate pedagogical and critical theory, while also focussing upon Constructivism and Transhumanism to examine and understand how AI offers new mapping replacing the conventional ideas on teaching and learning.

Analysis

AI's unparalleled influence on the education sector is redesigning the responsibilities and attitudes of both teachers and students, motivating them to adopt a combined work culture in a physical-digital space. In this hybrid workspace, learning mandates an interactive mode and the classroom is no longer a place to assert power dynamics. The teacher ceases to be the authoritative figure, allowing the learners to hone their critical thinking skills. The learners no longer adhere to standardized textbooks and engage in conventional modes of

assessment. The process of knowledge acquisition, which aligns with the tenets of Constructivism, is enabled through critical thinking, revisiting of prior knowledge, questioning and brainstorming sessions. This mode converts learning into an enterprising activity, permitting students to challenge, change and upgrade their understanding through intellectual sharing.

Lev Vygotsky pointed out that the cognitive development is influenced and shaped by cultural context and social and interactions. Vygotsky identified a gap between what a learner does independently and how he / she can improve through external scaffolding. This gap is bridged by the More Knowledgeable Other (MKO) who is conventionally a teacher or sometimes a peer. But in AI-supported classrooms, the MKO's role is not only played by the human teacher, but also by the powered AI tools. Although the human teacher continues to be the emotional mentor, the AI systems enrich the teaching-learning process through its ground-breaking contribution.

Transhumanism also advocates the use of technology in augmenting human capacities and enhancing human condition. One of the leading thinkers, N. Katherine Hayles, challenged the anthropocentric idea by introducing the revolutionary Integrated Cognitive Framework (ICF), which proposes that the concept of cognition is no longer distinctively human but includes all living and artificial systems. She envisions how humans and technology are co-evolving and transforming one another. Donna Haraway dismantled the rigid boundaries between man and machine, and supported hybridity and techno-cultural learning environments. In her seminal essay titled "The Cyborg Manifesto", the author uses the metaphor of Cyborg to break the human-machine dichotomy and further claims the reality of hybridity in the modern world. She remarked that, "Late twentieth-century machines have made thoroughly ambiguous the difference between natural and artificial, mind and body, self-developing and externally designed, and many other distinctions that used to apply to organisms and machines. Our machines are disturbingly lively, and we ourselves frighteningly inert" (Haraway, 1985, p. 69).

Bruno Latour, in We Have Never Been Modern (1991), discussed the multiple presence of the human, natural, political, cultural and technological as the 'imbroglio' which can never be separated or purified. This chaotic reality, according to Latour, is the Hybrid. In addition, Latour's new theoretical approach Actor Network Theory (ANT) explains a reality where human and non-human demand equal importance and evince unique capabilities to actively contribute towards structuring social life.

Although these thinkers did not discuss exclusively on the association between humans and technology, their theoretical scholarship strengthen our understanding on the unavoidable interdependence between the two.

Findings and Discussion

AI as Instructional Tool

Having contextualized the importance of educational theories that support AI assistance and changing pedagogy, it is essential to delineate how AI performs the task of an instructional tool. To cite a few, the First draft Generator is a versatile AI Assistant that facilitates the preparation of teacher's lesson plan, generates quiz questions and MCQs with key, and also creates rubrics for assessment. Besides playing multiple roles of a paraphraser, summarizer, social media writer, website writer and video script writer, this AI engine ensures quality writing.

The MagicSchool AI platform is specially designed to meet the needs of K - 12 teachers in terms of inquiry-based 5E Model Lesson comprising Engage, Explore, Explain, Elaborate, Evaluate pattern, assessment creation, and communication. Diffit is yet another AI-enabled differentiation tool that helps teachers create customized resources to cater to the needs of heterogeneous learners representing different grade levels.

Giving effective and timely feedback is another vital responsibility that helps learners fill the gap between their academic goals and progress. The formative feedbacks should not be intimidating but constructive, achievable and goal-oriented. The Gradescope is an assessment platform exclusively used by the Universities for STEM subjects. It is a neural network that competently scans handwritten-work and clusters the similar ones. Hence the grading time is saved, and the teacher effectively re-uses the rubrics. Instructors create on-the-fly rubrics that consistently update the scores of already submitted work.

This systematic feedback becomes an expedient follow-up for average scorers and slow learners to methodically work towards their achievable goals. The feedback can positively influence the learners to recognize their strengths and identify areas of improvement. Based on these feedback reports, the human teacher can render alternative and focussed guidance, gradually allowing the learner to adopt self-corrective endeavour that falls in line with the anticipated performance. This in turn positively reflects upon the learner's attitude towards self-appraisal, allowing renewed insights to overcome challenges and hazards. Considering the growing need for genuine, unbiased and consistent assessment reports, the incomparable technological support can certainly assist the human teacher in her / his mission to nurture the new generation of learners.

ETS e-rater is an AI engine which uses Natural Language Processing (NLP) to evaluate grammar, usage, writing style vocabulary density, organisation of ideas and analyses if the written text addresses the chosen topic. Besides, this e-rater houses constant feedback mechanism to monitor the academic improvement of the learners.

Artificial Intelligence has undoubtedly become an obligation to sophisticate human existence. The question about its vitality is extraneous and preposterous because its transformative power is augmenting every aspect of modern life. Many researchers and academicians have underscored AI's long-term importance and dynamism. Rane et al. (2025) emphasized that the applications of AI in HE curricula can offer sustainable educational approach: "The AI technology can also offer an efficient way of institutionalizing institutions of higher learning towards fulfilling their aspirations of sustainability besides boosting teaching and learning outcomes" (p. 6). It is also observed that AI-powered tools are bringing about a vibrant makeover and so, "AI in education should be viewed as a collaborative partner that augments teaching expertise, rather than a replacement" (McGriff, 2025, Conclusion section, para. 1). Although AI's high-quality automation and enhanced accuracy exhibit genuine concerns and apprehension over teacher agency, the positive speculation is that "the future of education lies in thoughtfully blending technological assistance with irreplaceable human wisdom" (McGriff, 2025, Conclusion section, para. 2).

Pedagogical Expertise and Changing Roles

In an AI-assisted educational situation, the teachers are expected to evolve with exceptional pedagogical expertise along with the updated knowledge of the AI systems. The educators

need to seamlessly collaborate with the generative AI keeping in mind the individual requirements of the learners and their academic objectives and learning outcomes. Working within this framework of complementary support, a classroom can become a productive place of knowledge-sharing and the conventional teacher-centred approach is replaced with the teacher playing the new role of a collaborator.

Teacher as Custodian of Customized Resources:

Gone is the day when a teacher used to adopt similar instructional practices and offer standardized learning materials to a class of 60 – 70 students. The Factory-model education that comprised of rigid schedules for raising passive learners has paved way for independent learners with academic flexibility. In an AI-assisted teaching-learning situation, teachers are incorporating hybrid models that privilege personalized and adaptive learning resources. Although the AI tools perform the role as content generator, the human teacher ensures quality, relevance and curates the resources depending upon the needs of learners. Based on the learning objectives, the teacher tailors the machine-generated content and affirms the unavoidable human involvement in spite of the machine's prospective support. This interpersonal interaction and human concern foster not only academic efficiency but also emotional wellbeing among learners. According to the insights and recommendations issued by the US Educational Technology in May 2023, "To succeed with AI as an enhancement to learning and teaching, we need to always center educators (ACE). Practically speaking, practicing "ACE in AI" means keeping a humanistic view of teaching front and center" (25).

Teacher as Ethical Guide

The objective of education centres upon the holistic growth of an individual, with sustained attention to intellectual, social, and ethical commitment. A balanced integration of these aspects nurtures individuals into responsible citizens, expanding their outlook from a self-centred vision to a larger obligation towards society at large. Whether it is the Gurukul or the Google classroom, the imposing presence of the teacher can never be overlooked as it the teacher who constructs the ethical backbone of education. The teacher is not a mere instructor but a mentor and role model.

The professional experience and decisions that get manifested in the teacher's work culture can greatly influence the learner, and the latter understands how prudently the teacher interprets and adapts rather than blindly incorporating the machine-generated content. Hence, it is true that the human teacher in collaboration with the AI systems can enliven the class room, and inspire the teachers and the learners to become active participants rather than passive consumers of information. The teacher's meticulous attempts to process data, assure its significance and convert them into bespoke learning resources that align with the eclectic demands of the learners show how classrooms are essentially human-centred spaces that engender positive peer energy and competence.

In compliance with the ethical requirements, the teacher's foremost responsibility is to sensitize the learners on the necessity to preserve moral standards and avoid misconduct. Plagiarism is offense as it violates academic integrity and fosters unethical research practices. It is the teacher who imparts the importance of AI literacy, and motivates learners to embrace techno-based educational systems efficiently without transgressing its ethical border. By providing right mentoring and guidance, the teacher functions to maintain academic honesty among learners. The learners can also be informed on the availability of AI-supported trustworthy plagiarism checkers.

Teacher as Stimulator of Critical thinking

The incorporation of sophisticated AI tools into classroom scenario has become a common practice to promote invigorating teaching and learning experiences. In this regard, the learners should understand the difference between passively consuming information and actively analysing it. In order to enable the students think critically, the teacher plays an inviolable part in kindling curiosity among learners. The theory of gravitational force was the scientific outcome of Isaac Newton's curiosity over the apple falling in a straight downward direction. Therefore, a teacher in an AI-enabled classroom can guide the learners towards inquiry-based learning and sharpen creative thinking, allowing free interplay of questioning, reasoning and mutual learning. They should be motivated to spend quality time analysing the resources critically, gauge its credibility and relevance, and comprehend its varied implications to make judgements and decisions. Besides, the current generation of students should be well-competent to meet the challenges at a global level. In a rapidly changing, technology-driven world, the learners should be equipped with other skills like innovative thinking, collaborative working and good communication. A teacher's role in tapping the higher order thinking skills among learners is appreciable and irreplaceable.

Drafting precise and focussed prompts is yet another task that requires teacher's guidance. The teacher, who effectively creates specific prompts, not generic, achieves the anticipated content. It has been identified that effective "ChatGPT usage requires strategic prompt engineering to achieve desired outcomes. For example, requesting "Create five discussion questions about the American Revolution for eighth-grade students focusing on cause-and-effect relationships" yields more targeted results than generic requests" (Ward, 2026, Educational Content section, para. 2). By helping the learners fix the objectives to contextualise their required resources, the teacher helps in fine-tuning or creating prompts, while constantly monitoring if the learners keep track of the resources so that continuity and revisions of the final version is done effectively. It is the teacher's duty to motivate students to critically examine the content and then adhere to its veracity.

Teacher's Classroom Management

It has been observed that, "Educators and technologists must work together to create a new educational paradigm where AI and human teachers operate as true partners. This vision sees teachers evolving into "learning architects" who orchestrate sophisticated educational experiences by leveraging AI tools while maintaining their crucial role as mentors and guides" (World Economic Forum, 2025). This statement defies the Human-AI incongruity, and highlights the synthesis of distinctive strengths of the human teacher and the efficacy of AI technology.

The teacher engagement lies primarily in the optimal use of AI tools in bringing about transformative teaching-learning experiences inside the classroom. For example, Carnegie Learning's MATHia platform combines teacher's guidance with sophisticated AI to analyse how students think through problems. With the help of LiveLab, teachers offer immediate intervention. The AI identifies specific skill gaps, allowing teachers to focus their attention while also maintaining the crucial human element in mathematics education (World Economic Forum, 2025). The AI-assisted classroom requires educators to be technically enriched and digitally adept enabling them to choose need-based AI tools and critically assess AI-generated content to meet the needs of learners.

The presence of AI systems alone can never humanize teaching-learning experiences, although AI simulates human conversations with the help of patterns. The Emotional Quotient of the human teacher is essential to address classroom stress, minimize negative peer pressure, build trust, improve academic growth and increase achievable goals. Hence, the teacher is accountable for cultivating teacher-learner interaction rather than automated machine-learner interaction, as the former accelerates not only academic but also social and emotional rapport. The human teacher adopts suitable instructional scaffolding techniques to guide the eclectic needs of diverse learners. Although AI involves in tutoring, teachers' scaffolding is important for academic development, inclusive classroom participation, social dynamics and mental wellbeing.

Research Questions Revisited

RQ1	In AI-assisted classroom, the teacher is the custodian of learning resources, regularly monitoring and customizing resources to meet the learners' needs. The teacher sharpens their critical thinking skills, fosters collaborative learning by maintaining quality tutoring, individuality and ethical standards.
RQ2	Pedagogy is progressing towards learner-centric methodology, drawing resourceful inputs using AI tools and educators focussing upon activities that require excellent evaluative and higher-order thinking skills. Adaptive digital platforms provide a self-paced, uninterrupted learning schedule. The educators are able to build rubrics that gel with educational objectives, and the availability of subsequent feedback systems afford sustained progress reports to the learners.
RQ3	Teacher engagement is challenging as the resources are universally accessible. However, the teacher's engaging personality, characterized by academic integrity, professional competence, emotional quotient and ethical principles, commands exceptional regard and attention of the learners. These dimensions of the teacher's personality add 'human-colour' in AI-enabled classrooms.
RQ4	The educators are responsible for sensitizing the learners on the institutional mission and vision statements. Besides, Digital literacy skills are to be taught alongside deft handling of AI tools. Extensive inputs on the consequences of plagiarism should be a part of academic learning and teaching. A teacher's impartial behaviour can greatly influence learners' positive behaviour and good conduct.

Challenges and Concerns

Despite the rapidity in handling and performing multiple tasks, AI is incompetent in recognizing human emotions in spite of its capabilities as a simulator. AI is incapable of processing an individual's subjective experiences, although it can identify data-based simulations. It is here the human-centric scaffolding – academic, social and emotional – of a teacher or mentor becomes indispensable.

The Northwest Council for Computer Education (NCCE) identified the paramount importance of safeguarding Privacy and Security when AI is integrated into the classrooms. The Council recommended that the "Educational institutions have an obligation to

implement robust protection measures that comply with applicable privacy regulations and adequately safeguard student information" (NCCE, 2025, Privacy and Security section).

Owing to high automation and extreme sophistication, the AI system breaks down complicated tasks and coordinates rapid workflow, ensuring utmost accuracy without human interference. This might lead to increased technology-orientation, which could result in less human dependence and trust. AI tools undoubtedly improve the educational framework but can never replace human teachers, and "the future of education lies in empowering young learners to embrace and develop their uniquely human qualities – those unlikely to ever be replaced by technology" (World Economic Forum, 2023). Concurrently, excessive dependence on AI tools may lead to inadvertent plagiarism, causing the learner to violate professional ethics and trespass ethical boundaries. Another aspect of profuse machine dependence is intellectual lethargy, which can impair the cognitive skills of learners.

There are other challenges like lack of even accessibility to modern technologies, technological sophistication as prerogative of the powerful, and inadequate digital literacy to augment professional competence among educators:

We recognise the diversity of needs and challenges faced by teachers across the globe, particularly those living and working in contexts with multiple and complex vulnerabilities in African countries facing the most acute needs, Least Developed Countries (LDCs) and Landlocked Developing Countries (LLDCs) and Small Island Developing States (SIDS), as well as the specific challenges faced by middle- income countries, those affected by crisis, including conflicts and post-conflict situations. (UNESCO, 2025, p. 3)

Besides, there are quantitative research inputs that deal with humans' inexplicable anxiety and fear or phobia towards technology, which is termed technophobia. All of these challenges can neither be overcome nor evaded, but they have to be addressed wisely as the future of Education demands that we "strengthen teachers' digital and AI competencies through initial and continuous professional development so that education technologies may be co-created and utilized by teachers to amplify the relational and affective dimension of learning without replacing the creativity, core competencies and pedagogical knowledge of teachers" (UNESCO, 2025, p. 6).

Conclusion

The concluding observation of the study is a clarion call to the Educational stakeholders across the globe to enrich the present curriculum structure by emphasizing the importance of technology-friendly and human-centric academic environment. By assuring inclusivity, state-of-the-art practices, cultural sensitivity, social intelligence and emotional maturity, AI-embedded teaching-learning spaces can implement need-based and learner-centric methodologies in accordance with the benchmarks suggested in UN Sustainable Development Goal 4. In this fast-paced environment with highly mechanized access systems, life-long learning, collaborative academic initiatives and sustained progression can greatly improve cognitive abilities: "The Education 4.0 Taxonomy, paired with the World Economic Forum's Global Skills Taxonomy (to which the Education 4.0 Taxonomy elements are seamlessly matched), provides a blueprint for holistic lifelong learning that can take place within, and beyond, the formal classroom setting" (World Economic Forum, 2023).

Learners become innovative thinkers - potential AI tool generators, system designers and workflow organisers - rather than indolent consumers of technological privileges. Nevertheless, the lasting impact of a technology-driven education depends on the convergence of human and technological 'actants' (borrowing Bruno Latour's term), allowing teachers to play the pivotal role in chiselling the social, moral and emotional dimensions of the learners' wellbeing.

Scope for further Extensive Research

i) AI-powered Framework exclusively for Higher Secondary Education
ii) AI in Medical Education
iii) AI Tools for Slow Learners
iv) AI-enabled Systems for the Differently-Abled

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Artificial Intelligence in Medical Education

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Abstract

The integration of Artificial Intelligence into education is creating a major shift in how students learn, especially in medical courses such as MBBS and paramedical studies. Traditional learning methods are being enhanced with interactive and technology driven approaches. This research paper titled AI in Medical Education aims to explore how AI is transforming the teaching of medical courses by making learning more visual, practical and engaging for students. Methods: The study adopts a descriptive approach by analyzing modern AI-based learning tools such as virtual models, simulation based training and virtual reality environments used in medical education. These tools allow students to experience real life medical situations in a controlled and safe environment. This paper will unravel or reveal how AI can help students in understanding complex concepts like human anatomy through 3D visualization and improves the clinical skills through simulations and thereby increases confidence in them, by allowing them to have repeated practice without risk. It also enhances student engagement and reduces learning errors. However, challenges such as high implementation cost, technical dependency and limited accessibility are also identified. Conclusion: AI is revolutionizing medical education by bridging the gap between theory and practice. With proper use, it can create more skilled and confident healthcare professionals for the future. Even Learning medicine is no longer limited to textbooks. Today, with Artificial Intelligence, students can explore the human body in 3D, practice surgeries in virtual environments and learn without fear of mistakes.

Keywords: Artificial Intelligence, Interactive Learning, Medical Education, Simulation, Virtual Reality

Introduction

Medical education is important for developing skilled healthcare professionals. Traditionally, medical students learn through lectures, textbooks, laboratory work and clinical practice. Although these methods are useful, they often follow the same teaching style for all students, regardless of individual learning abilities. Another challenge is limited clinical exposure because students may not always have access to real patients due to safety and ethical concerns. This can reduce practical learning opportunities. Artificial Intelligence (AI) provides new solutions to these challenges. AI refers to computer systems that can perform tasks such as learning, reasoning and problem-solving. In medical education, AI is used in adaptive learning platforms, virtual simulations and intelligent tutoring systems. AI helps students learn at their own pace by analyzing their performance and providing personalized content. Technologies such as VR and AR also allow students to practice medical procedures in safe simulated environments. Despite these advantages, AI

integration also has challenges such as data privacy issues, high costs and reduced human interaction. Therefore, this study examines the role, benefits and challenges of AI in medical education.

Review of Related Literature

Many studies show that AI improves medical education, Smith (2022) stated that AI supports personalized learning and improves student performance. Brown (2021) explained that AI-based systems increase student engagement and learning efficiency. Johnson and Lee (2020) highlighted the importance of intelligent tutoring systems in providing continuous guidance and feedback. Biggs and Tang (2011) introduced the concept of constructive alignment, which focuses on aligning learning outcomes, teaching methods and assessments.

However, researchers also mention challenges such as ethical concerns, algorithmic bias and lack of technical skills.

Objectives

The objectives of this study are:

1. To examine the role of AI in medical education.
2. To identify the benefits of AI integration.
3. To analyse the challenges of AI implementation.
4. To explore the future of AI in healthcare training.

Methodology

This study adopts a qualitative research methodology using a documentary research design to explore the role of Artificial Intelligence in medical education.

Research Design

The research is descriptive in nature and focuses on analyzing existing literature to understand the applications and impact of AI in medical education. The study does not involve primary data collection but relies on secondary sources to draw conclusions.

Data Collection

Data were collected from a wide range of credible sources, including:

- Academic journals
- Books
- Conference papers
- Policy reports
- Online databases such as PubMed, Google Scholar and ScienceDirect

Only relevant and recent sources were selected.

Analysis

The collected data were analyzed using thematic analysis. Key themes were identified based on recurring patterns and insights in the literature. The analysis focused on:

- Applications of AI in medical education
- Benefits of AI integration
- Challenges and limitations
- Future implications

The study is guided by the concept of constructive alignment, which emphasizes aligning learning outcomes, teaching methods and assessment strategies to improve educational effectiveness.

AI helps students learn according to their abilities and learning speed. Adaptive learning platforms provide personalized educational content.

Clinical Training

VR and AR technologies improve practical learning through virtual clinical simulations. Students can safely practice medical procedures multiple times.

Student Assessment

AI-based systems support automated grading and provide immediate feedback. Predictive analytics can identify weak students early.

Findings and Discussion

The findings of this study highlight the significant role of Artificial Intelligence in transforming medical education. The **key roles are summarized in the table** below.

Table 1. Major Roles of Artificial Intelligence in Medical Education

Themes	Role of Artificial Intelligence
In Defining Learning Outcomes	AI helps identify industry-relevant competencies by analysing healthcare trends and workforce requirements.
In Teaching-Learning Activities	Adaptive learning platforms personalize content based on student needs. VR and AR enable immersive clinical simulations. Intelligent tutoring systems provide real-time guidance and feedback. AI Chabot support continuous learning

In Student Assessment	Automated grading improves efficiency and accuracy. Predictive analytics identify at-risk students Continuous feedback enhances learning outcomes.
In General	AI improves administrative efficiency and supports research and innovation.

The integration of AI into medical education has resulted in several transformative changes

The study identified the following major findings regarding Ai in medical education:

- AI improves personalized and adaptive learning.
- VR and AR enhance practical clinical training.
- Intelligent tutoring systems provide continuous feedback.
- Automated assessment systems improve evaluation efficiency.
- AI increases accessibility through remote learning opportunities.
- Ethical and technical challenges remain major concerns.

These challenges must be addressed to ensure responsible implementation.

Conclusion

Artificial Intelligence is improving medical education by making learning more personalized, interactive and efficient. AI technologies such as adaptive learning systems, VR and intelligent tutoring systems help students improve both theoretical and practical skills. However, challenges such as ethical issues, data privacy and high costs must be carefully managed. AI should support traditional teaching methods rather than replace them completely. In conclusion, AI has great potential to improve healthcare education and develop competent healthcare professionals.

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Transforming Physics Through Artificial Intelligence: A Comparative Study of Pre-AI and Post-AI Eras

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Abstract

This research paper looks at how physics has changed over time from the way of doing things before artificial intelligence to the new way of doing things with artificial intelligence. For a time, physicists used mathematical solutions to understand the world. With artificial intelligence physicists can now use machine learning and artificial neural networks to do their work. This paper looks at two areas of physics: non-linear dynamics and astrophysics. It shows how artificial intelligence can help physicists do their work faster and better. It also shows that artificial intelligence has its own problems. This paper says that the future of physics is not about using artificial intelligence but about using artificial intelligence and classical physics together.

Keywords: Artificial Intelligence, Computational Physics, Exoplanets, Machine Learning, Non-linear Dynamics

Introduction

Physics has always tried to make sense of the world by using powerful mathematical ideas. From Isaac Newton to today physicists have used these ideas to understand the world. As physics has gotten more complex it has become harder to use just mathematical solutions. Physicists have had to use computers to help them. Now they are using artificial intelligence.

The old way of doing physics before intelligence used numerical methods like the Runge-Kutta method. These methods were good. They had problems. They were slow. Could not handle complex systems. With intelligence physicists can now use machine learning and artificial neural networks to do their work. These new methods are faster. Can handle complex systems but they also have problems. They are not transparent. It is hard to understand how they work.

Review of Related Literature

The way physicists do their work has changed over time. Before computers physicists used solutions to understand the world. With computers physicists started using methods like the Runge-Kutta method. In the 1960s physicists started using computers to simulate systems. With artificial intelligence physicists can now use machine learning and artificial neural networks to do their work. One of the papers on using artificial intelligence in physics was written by Carleo and Troyer in 2017. They showed how artificial neural networks could

be used to solve the many-body problem. Since then many papers have been written on using intelligence in physics. Pathak et al. showed how reservoir computing could be used to learn the phase space of chaotic systems. Shallue and Vanderburg showed how a Convolutional Neural Network could be used to detect exoplanets.

Objectives

The first objective of this paper is to compare the way of doing physics with the new way of doing physics with artificial intelligence. The second objective is to evaluate the effectiveness of intelligence in experimental data analysis. The third objective is to construct a reference matrix that outlines the operational methodologies, primary applications and fundamental limitations of both paradigms. The fourth objective is to analyze the epistemological shift in physics addressing the transition from explicit transparent mathematical derivation to implicit opaque algorithmic optimization. The research questions are: How do iterative solvers and trained neural networks differ in terms of computational cost? When there is a lot of noise in data at what point do traditional analytical models stop working? Does relying on intelligence that is not transparent compromise the main goal of physics?

Methodology

To compare the pre-AI and post-AI eras in a way that is robust and scientifically valid this research uses a comparative methodology that looks at two case studies. This framework is designed to contrast algorithmic processing with stochastic data-driven optimization. By focusing on two sub-fields non-linear dynamics and experimental astrophysics the study ensures that the findings are applicable to both computational simulation and data analysis.

The Pre-AI Framework

The pre-AI methodology is based on deduction. It assumes that the laws governing the system are perfectly known, such as Newtons Second Law or Maxwells equations. The process involves translating these differential equations into discrete difference equations that a computer can process iteratively. In this study the pre-AI framework is represented by the 4th-order Runge-Kutta method. This method calculates the state of a system at a given time by evaluating the derivative at four points computing a weighted average to achieve a highly accurate prediction. However, this framework has a limitation: it is sequential meaning that the state at a later step cannot be computed without first computing all previous steps.

The Post-AI Framework

The post-AI methodology is based on induction. Than explicitly programming the physical equations a machine learning architecture is instantiated with randomized internal parameters. The framework relies on a training phase, where the model is fed amounts of data either from real-world experiments or generated by high-fidelity pre-AI simulations. Through the process of backpropagation and gradient descent the algorithm iteratively adjusts its weights to minimize a predefined loss function.

Findings and Discussion

The application of the methodology yields insights into the differences between the pre-AI and post-AI eras of computational physics. This section presents an in-depth analysis of the two case studies highlighting the divergence in error handling, speed and feature extraction.

Case Studies Analysis

In simulating the double pendulum, the pre-AI Runge-Kutta method demonstrates the value of mathematical rigor. However the analysis reveals a critical failure point to deterministic methods in chaotic regimes. The post-AI neural network approach redefines the problem creating a topological map correlating inputs to outputs. The training phase requires computational power but once trained the inference time is fractions of a millisecond.

The analysis of astrophysics data provides a compelling argument for the integration of artificial intelligence. The post-AI application of a Convolutional Neural Network resolves the issue of noise through feature extraction. The neural network learns what a transit looks like under an array of noisy conditions isolating only the specific 'U-shape' characteristic of a planetary transit.

Table 1. Reference Table of Methodological Comparisons

Parameter	Pre-AI Era	Post-AI Era
Core Mechanism	Explicit deduction, formulas	Implicit induction, data-driven algorithms
Computational Speed	Slow at execution scales poorly	Slow at training nearly instantaneous at execution
Interpretability	Complete transparency	Severe opacity neural weights
Handling of Noise	Highly susceptible	Highly robust convolutional layers

Epistemology of the Black Box

The move from physics to physics that uses artificial intelligence is changing the way we think about knowledge. For a time physics has been about breaking down complex systems into smaller parts and describing them with math. With artificial intelligence we can get the right answer without really understanding how it works. This is because artificial intelligence models are like boxes. We put in the data and get out the answer but we do not really know what is going on inside. One solution to this problem is to use something called Physics-Informed Neural Networks. These are intelligence models that are designed to follow the basic laws of physics.

Conclusion

The move from physics to physics that uses artificial intelligence is a big deal. Traditional methods are still important because they are transparent and follow the laws of physics. Artificial intelligence can do things that traditional methods cannot. It can handle huge amounts of data and do simulations really fast. The problem is that artificial intelligence can be a box and we need to be careful not to lose sight of what is really going on.

So what does this mean for the future of physics? It means that physicists need to be able to speak two languages. The language of physics and the language of artificial intelligence. They need to know how to use intelligence to get results but also how to understand what

those results mean. This is especially important for students who are just starting out in physics.

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Transforming Education through AI, Media, and Technology

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Abstract

The rapid advancement of Artificial Intelligence (AI), digital media, and modern technology has significantly transformed the education sector in recent years. Traditional teaching methods are gradually evolving into more interactive, flexible, and student-cantered approaches. This paper examines how the integration of AI, media, and technology enhances learning experiences and improves educational outcomes. The study follows a qualitative and conceptual approach based on existing literature and educational practices. AI-based systems support personalized learning by adapting educational content according to student needs and learning patterns. Digital media, including videos, simulations, and interactive platforms, improves student engagement and simplifies complex concepts. Technology also enables online learning, virtual classrooms, and access to educational resources beyond geographical boundaries. However, challenges such as the digital divide, limited access to technological resources, lack of digital literacy, and concerns regarding data privacy are also discussed. The findings indicate that while AI, media, and technology offer numerous benefits, effective implementation requires proper infrastructure, teacher training, and balanced usage.

Keywords: Artificial Intelligence, Digital Media, Educational Technology, Online Learning, Personalized Learning, Student Engagement

Introduction

According to the Education is one of the most important pillars of social and economic development. It plays a significant role in shaping individuals, developing skills, and improving the quality of life. Traditionally, education relied mainly on classrooms, textbooks, lectures, and direct teacher-student interaction. Although these methods have been effective for many years, they often lacked flexibility, personalization, and accessibility.

The development of Artificial Intelligence (AI), digital media, and modern technology has transformed educational systems worldwide. Today, students can learn not only through textbooks and classroom lectures but also through online platforms, educational applications, interactive videos, and virtual learning environments. Technology has changed the way teachers teach and students learn. Modern education focuses more on active participation, collaboration, creativity, and personalized learning experiences.

Artificial Intelligence has become an important component of modern education. AI-based systems can analyze student learning patterns, identify strengths and weaknesses, and provide personalized learning support. Educational media such as videos,

animations, podcasts, and digital simulations make learning more engaging and easier to understand. Similarly, technology has enabled distance learning, online assessments, and virtual classrooms that support flexible learning opportunities.

The transformation became especially visible during the COVID-19 pandemic when educational institutions worldwide shifted to online learning platforms. This situation highlighted the importance of technology in ensuring continuity in education. As a result, schools and universities increasingly adopted digital tools and online teaching methods.
This paper aims to explore the role of AI, media, and technology in transforming education. It also examines their benefits, challenges, and future implications for students, teachers, and educational institutions.

Review of Related Literature

According to Many researchers and educational experts have studied the impact of AI, media, and technology on education. Existing literature shows that technological advancements have significantly improved learning experiences and educational accessibility.

According to Holmes et al. (2019), Artificial Intelligence supports adaptive learning systems that provide personalized educational experiences for students. AI tools help identify learning difficulties and recommend appropriate learning materials based on individual performance.

Selwyn (2016) explained that digital technology has changed the relationship between students and knowledge. Students are no longer dependent only on teachers for information because online resources and digital platforms provide access to unlimited educational content.

Research by Mayer (2014) highlighted the importance of multimedia learning. The study found that students understand and remember concepts more effectively when information is presented through visuals, animations, and audio rather than only through written text.

Similarly, UNESCO (2021) emphasized that technology-enabled education improves access to learning opportunities for students from remote and underprivileged areas. Online education platforms have allowed learners worldwide to continue education during emergencies such as the COVID-19 pandemic.

However, several studies also discuss the challenges of technological integration in education. According to OECD reports, unequal access to devices and internet connectivity creates a digital divide among students. Researchers also highlight concerns regarding data privacy, cybersecurity, and over-dependence on technology.

Overall, previous studies indicate that AI, media, and technology provide significant educational benefits but also require responsible and balanced implementation.

Objectives

The major objectives of this study are:

- To examine the role of Artificial Intelligence in education.

- To analyze the impact of digital media on student learning.
- To study the importance of technology in modern education.
- To identify the benefits and challenges of integrating AI, media, and technology in education.
- To explore future trends and opportunities in digital education.

Methodology

This study follows a qualitative and conceptual research methodology. Information for the study was collected from academic journals, educational websites, books, online reports, and previous research papers related to AI, media, and educational technology.

- Sources of Data
- Research articles
- Educational journals
- Government and UNESCO reports
- Online educational platforms
- Method Used

The collected information was analyzed to understand how AI, media, and technology influence teaching and learning practices. The study mainly focuses on conceptual understanding and practical educational applications.

Analysis

Role of Artificial Intelligence in Education

Artificial Intelligence is transforming education by improving teaching efficiency and learning experiences. AI refers to computer systems capable of performing tasks that usually require human intelligence, such as reasoning, problem-solving, and decision-making. One major contribution of AI is personalized learning. Every student learns differently, and AI systems can adjust learning content according to individual student performance and needs. Students who struggle with certain subjects can receive additional support and practice materials.

AI-powered tutoring systems provide immediate feedback and guidance to students. These intelligent systems help learners understand concepts independently without waiting for teacher assistance. AI chatbots are also used to answer student questions at any time. Automated grading systems save time for teachers by evaluating assignments and examinations quickly and accurately. This allows teachers to focus more on teaching and student interaction.

AI also supports predictive analytics in education. Educational institutions can analyze student performance data to identify students at risk of academic failure and provide early support.

Table 1. Applications of AI in Education.

AI Application	Purpose
Intelligent Tutoring Systems	Personalised learning support
Automated Grading	Reduces teacher workload
Chatbots	Student assistance

Predictive Analytics	Identifying learning difficulties

Although AI improves efficiency, excessive dependence on automated systems may reduce human interaction in education. Therefore, AI should be used as a supportive tool rather than a replacement for teachers.

Impact of Media in Education

Digital media has become an important part of modern learning environments. Educational media includes videos, animations, podcasts, presentations, and interactive digital platforms that improve student engagement and understanding.

Visual learning through media helps students understand difficult concepts more easily. For example, science experiments and mathematical concepts can be explained effectively through animations and simulations.

Educational videos allow students to learn at their own pace. Students can pause, replay, and review lessons whenever necessary. Platforms offering educational videos have become valuable resources for independent learning.

Podcasts support auditory learning and are useful for discussions, storytelling, and language learning. Interactive media such as quizzes and educational games also make learning more enjoyable and engaging.

Social media platforms support communication and collaboration among students and teachers. Educational communities and online discussion groups encourage knowledge sharing and teamwork.

Figure 1: Media-Based Learning Process

Digital Media → Interactive Learning → Student Engagement → Better Understanding

Despite its advantages, media usage may also lead to distractions and excessive screen time if not managed properly.

Role of Technology in Education

Technology provides the infrastructure that supports AI and digital media in education. Modern classrooms increasingly use digital tools such as smart boards, computers, projectors, tablets, and cloud-based platforms. Online learning platforms enable students to attend classes remotely from any location. Virtual classrooms became highly important during the COVID-19 pandemic when educational institutions shifted to remote learning.

Mobile learning applications allow students to access educational content anytime and anywhere. Cloud computing enables easy sharing of study materials, assignments, and academic resources.

Technology also supports students with disabilities through assistive tools such as screen readers, voice recognition systems, and subtitles.

Table 2: Benefits of Technology in Education

Technology Tool	Educational Benefit
Online Platforms	Flexible learning
Smart boards	Interactive teaching
Cloud Storage	Easy access to material
Mobile Applications	Learning anytime

However, technology requires proper infrastructure, internet access, and technical knowledge for effective implementation.

Findings and Discussion

The analysis shows that AI, media, and technology positively influence educational systems in several ways. Personalized learning improves student understanding and academic performance. Interactive media increases student motivation and engagement. Online learning platforms provide educational opportunities to students who may not have access to traditional classrooms.

At the same time, several challenges remain. Students from economically weaker backgrounds may lack access to devices and internet connectivity. Teachers also require training to effectively use technological tools.

The findings indicate that technology alone cannot solve all educational problems. Human interaction, emotional support, and teacher guidance remain essential components of effective education.

The study identified the following findings:

- AI improves personalized learning experiences.
- Media-based learning increases student engagement.
- Technology enhances flexibility and accessibility in education.
- Online learning supports continuity during emergencies.
- Digital inequality remains a major challenge.
- Teacher training is necessary for effective implementation.

Challenges and Limitations

Several challenges affect the successful integration of AI, media, and technology in education.

Digital Divide

Many students lack internet access and digital devices.

Privacy and Security

Educational platforms collect student data, creating privacy concerns.

Technical Difficulties

Poor internet connectivity and software issues affect online learning experiences.

Over-Dependence on Technology
Excessive use of digital devices may reduce critical thinking and face-to-face interaction.

Future Scope
The future of education will become more technology-driven. AI-powered classrooms, Virtual Reality (VR), and Augmented Reality (AR) technologies will create immersive learning experiences.

Future educational systems may include:

- Virtual laboratories
- AI-based career guidance systems
- Smart classrooms
- Global online collaboration

Educational institutions must ensure equal access and ethical use of technology to maximize benefits.

Expanded Analysis and Discussion
The transformation of education through AI, media, and technology has created major changes in teaching methods, student learning experiences, and educational administration. These changes are not limited to developed countries alone but are gradually influencing educational systems around the world. Educational institutions are now moving from traditional teacher-centered learning to more student-centered and technology-supported learning environments. One of the most noticeable impacts of AI in education is the ability to personalize learning. In traditional classrooms, teachers often teach the same content to all students regardless of their learning abilities or interests. However, AI systems can identify individual learning patterns and provide customized learning experiences. This allows students to learn according to their own pace and understanding levels. Personalized learning improves student confidence, motivation, and academic performance.

Another important development is the use of intelligent tutoring systems. These systems provide continuous academic support to students by answering questions, giving explanations, and recommending learning resources. Such systems are especially useful for students who hesitate to ask questions in classrooms. AI-powered educational tools also help students practice problem-solving skills independently. Digital media has also changed the learning environment significantly. Visual and audio-based learning methods are often more effective than traditional text-based methods. Students today are more comfortable learning through videos, animations, and interactive simulations. Educational media helps simplify difficult topics and improves knowledge retention. For example, complex scientific processes can be understood more clearly through animated demonstrations than through textbook descriptions alone.

Media also encourages active participation in learning. Interactive educational platforms allow students to engage in quizzes, group discussions, collaborative projects, and simulations. This increases student involvement and creates a more dynamic learning environment. Educational podcasts and recorded lectures provide

additional flexibility because students can access learning materials at convenient times.

Technology has also improved communication between teachers and students. Online platforms enable teachers to share assignments, provide feedback, and conduct discussions beyond classroom hours. Cloud-based systems make it easier for students to access learning resources from multiple devices. These technologies have made education more flexible and accessible. However, despite these advantages, there are several concerns regarding the excessive use of technology in education. Students may become overly dependent on digital tools and lose interest in traditional reading and writing skills. Excessive screen time may also affect physical health, including eye strain and reduced physical activity. Therefore, educational institutions should encourage balanced use of technology.

Teacher training is another important factor in successful technological integration. Many educators face difficulties in adapting to modern teaching technologies due to lack of technical skills or training opportunities. Proper professional development programs are necessary to help teachers effectively use AI and digital tools in classrooms. Another important issue is the digital divide. Students from rural or economically weaker backgrounds may not have access to internet services, laptops, or smartphones. This inequality limits the effectiveness of online learning and creates educational gaps between students. Governments and educational institutions must focus on improving digital infrastructure and providing affordable technological resources.

The study also highlights ethical concerns related to AI in education. AI systems collect and analyze large amounts of student data. Without proper privacy protection, this data may be misused. Educational institutions must ensure data security and ethical use of AI technologies. Overall, the analysis indicates that AI, media, and technology provide numerous opportunities for improving education, but their successful implementation depends on responsible usage, equal accessibility, proper infrastructure, and continuous teacher support.

Additional Case Studies

Case Study 1: Online Education During COVID-19

The COVID-19 pandemic had a major impact on educational systems worldwide. Schools, colleges, and universities were forced to close temporarily to prevent the spread of the virus. During this period, online learning became the primary method of continuing education.

Educational institutions adopted online platforms for conducting virtual classes, sharing study materials, and evaluating students. Applications such as video conferencing platforms enabled teachers to interact with students remotely. AI-based learning systems also supported students through automated quizzes, recorded lectures, and personalized recommendations. The pandemic demonstrated the importance of technology in maintaining continuity in education. However, it also exposed inequalities among students. Many students from rural and low-income families faced difficulties due to lack of internet access and digital devices.

Despite these challenges, the pandemic accelerated digital transformation in education and encouraged institutions to adopt blended learning models that combine online and offline teaching methods.

Case Study 2: AI-Based Learning Applications

Several educational institutions have introduced AI-powered learning applications to improve student performance. These applications analyze student learning behavior and provide personalized recommendations. For example, language learning applications use AI to identify pronunciation errors and suggest improvements. Mathematics learning platforms analyze student mistakes and provide step-by-step explanations. Such systems improve student confidence and encourage self-learning.

AI-based educational applications are especially useful for competitive exam preparation because they help students identify weak areas and improve their performance through continuous practice.

Case Study 3: Smart Classrooms

Smart classrooms use digital boards, projectors, internet connectivity, and multimedia resources to create interactive learning environments. Teachers can display videos, animations, and presentations during lessons, making classes more engaging.

Smart classrooms encourage collaboration and improve student participation. Students can access digital notes and participate in online assessments directly from classroom devices. Such environments also support hybrid learning models where students can attend classes both physically and virtually.

Additional Findings

The study reveals several important findings regarding the integration of AI, media, and technology in education:

Students show higher engagement levels when multimedia content is used in classrooms.

AI-based personalized learning improves academic performance and confidence.

Online learning platforms increase flexibility and accessibility for learners.

Technology supports independent learning and self-assessment.

Teachers benefit from automated administrative systems and digital teaching tools.

Digital inequality remains one of the biggest barriers to effective online education.

Proper training and infrastructure are necessary for successful technological integration.

Educational Implications
The integration of AI, media, and technology has several implications for educational institutions and policymakers.

For Teachers
Teachers must continuously update their digital skills and adapt to new teaching technologies. Technology should be used to enhance teaching quality rather than replace traditional teaching completely.

For Students
Students need digital literacy skills to effectively use educational technologies. They should also learn how to balance online learning with traditional study habits.

For Institutions
Educational institutions must invest in digital infrastructure, teacher training, and cybersecurity measures. They should also ensure equal access to educational resources for all students.

For Governments
Governments should focus on reducing the digital divide by improving internet access and providing affordable digital devices to students from economically weaker backgrounds.

Recommendations
Based on the findings of the study, the following recommendations are suggested:

- Educational institutions should provide regular digital training programs for teachers.
- Governments should improve internet connectivity in rural areas.
- Schools and colleges should adopt blended learning models.
- Educational platforms should ensure student data privacy and security.
- Technology should be used in a balanced manner to avoid over-dependence.
- Institutions should encourage interactive and student-centered learning approaches.

Conclusion

Artificial Intelligence, media, and technology are reshaping the future of education. They have transformed traditional learning environments into more interactive, accessible, and flexible systems. AI supports personalized learning, media improves engagement, and technology provides global access to educational resources. The integration of these innovations became particularly important during the COVID-19 pandemic, highlighting the importance of digital education systems. Although several challenges such as the digital divide, privacy concerns, and technical limitations remain, the overall impact of AI, media, and technology on education is highly positive.

The future of education will continue to depend on technological advancements. However, technology should not replace the human aspects of education such as emotional support, communication, and critical thinking development. A balanced approach that combines technology with effective teaching practices is essential for creating a successful and inclusive education system. With proper planning, ethical

implementation, and equal access to resources, AI, media, and technology can help build a future-ready educational environment that benefits students, teachers, and society as a whole.

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Artificial Intelligence and Human Imagination in Literature: Creativity, Originality, and the Future of Digital Writing

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Abstract

The rapid expansion of Artificial Intelligence technologies has transformed almost every area of human activity, including education, literature, and creative writing. AI- powered writing systems such as ChatGPT, Gemini, Grammarly, Jasper AI, and Sudowrite are increasingly used by students, researchers, content creators, and professional writers for idea generation, grammar correction, storytelling, and academic writing. Although these technologies improve efficiency and accessibility, they also raise serious concerns regarding originality, creativity, emotional authenticity, and the future of human imagination in literature. This study critically examines the relationship between Artificial Intelligence and imaginative literary expression. The research adopts a mixed conceptual and survey-based methodology involving undergraduate students aged between 18 and 24 years. The findings reveal that AI tools significantly support productivity and writing speed, but excessive dependence on AI may negatively affect independent thinking, originality, emotional depth, and imaginative engagement. The study further explores the ethical implications of AI-generated literature, including authorship ambiguity, plagiarism concerns, and cognitive dependency. The paper concludes that AI should function as a supportive instrument rather than a replacement for human creativity. Human imagination, emotional consciousness, and cultural experience remain central to authentic literature. A balanced integration of AI and creative thinking is therefore essential for sustaining originality and meaningful literary expression in the digital age.

Keywords: AI-assisted Writing, Artificial Intelligence, Creativity and Originality, Digital Literature, Human Imagination

Introduction

Literature has historically represented one of the most powerful forms of human imagination and emotional expression. Through poetry, fiction, drama, folklore, and philosophical narratives, literary works have preserved human experiences, social realities, cultural identities, and emotional complexities across generations.

Traditionally, literature emerged from observation, memory, imagination, creativity, and intellectual reflection. Human writers transformed lived experiences into artistic narratives capable of emotionally connecting with readers across cultures and historical periods. However, the rapid growth of Artificial Intelligence technologies has begun to fundamentally reshape literary creation and writing practices around the world. In recent

years, AI-powered tools such as ChatGPT, Gemini, Jasper AI, Grammarly, Copy.ai, and Sudowrite have become widely used among students, researchers, journalists, marketers, and creative writers. These systems can generate essays, poems, stories, scripts, and articles within seconds. AI systems are increasingly capable of mimicking writing styles, generating coherent narratives, and assisting users in various forms of creative expression. The rise of generative AI after the public emergence of ChatGPT in 2022 accelerated debates regarding creativity, originality, and authorship. Educational institutions, publishing industries, and literary scholars have begun questioning whether AI-generated writing can truly be considered literature. While AI systems are capable of producing grammatically accurate and structurally coherent texts, critics argue that such outputs lack emotional consciousness, lived experiences, moral depth, and authentic imagination. One of the major concerns associated with AI-assisted writing is cognitive dependency. Students increasingly rely on AI systems for brainstorming, summarization, assignment writing, and idea generation. Although this improves efficiency, excessive dependence on

AI may weaken critical thinking and independent imaginative capacity. Literature is not simply the arrangement of words; it represents emotional consciousness, symbolic meaning, human suffering, cultural identity, and philosophical reflection. Human imagination remains deeply connected to emotional memory and social experience, which cannot be entirely replicated through algorithmic prediction. The COVID-19 pandemic further accelerated digital learning and AI adoption. During online education periods, students became increasingly dependent on digital writing assistants and automated systems. Consequently, the boundaries between machine-assisted writing and independent creative thought became blurred. This transformation has created a new intellectual environment where AI functions not only as a technological tool but also as a cognitive collaborator. This study critically analyses the relationship between Artificial Intelligence and human imagination in literature. It explores both the positive and negative implications of AI-assisted writing, examines students' perceptions regarding originality and creativity, and evaluates whether AI threatens the future of imaginative literary expression.

Review of Related Literature

Human imagination has historically functioned as the foundation of literary creativity. Aristotle's concept of mimesis explained literature as an artistic imitation of life and human action. Romantic writers such as William Wordsworth and Samuel Taylor Coleridge later emphasized imagination as the central force behind poetic creativity. According to Romantic literary theory, imagination enables writers to transcend logic and produce emotionally meaningful artistic expression. Modern creativity studies define creativity as the production of ideas that are both original and valuable. Runco and Jaeger argued that originality remains one of the essential dimensions of creativity. Human creativity is deeply connected to emotional experience, memory, cultural context, and subjective consciousness. Artificial Intelligence has increasingly entered the field of creative writing through Natural Language Processing and machine learning systems. Large Language Models such as GPT-based systems generate text by predicting linguistic patterns from massive datasets. Russell and Norvig explained that AI systems simulate aspects of human intelligence through algorithmic processing and data-driven learning. Recent studies demonstrate that AI tools significantly improve writing productivity, grammar correction, idea generation, and accessibility. Kasneci et al. highlighted both the opportunities and risks associated with generative AI in education.

Students often use AI systems to overcome writer's block and improve writing efficiency. However, researchers also warn that excessive dependence on AI may reduce critical engagement and intellectual independence. Floridi and Chiriatti emphasized that systems like GPT-3 imitate human language without possessing genuine understanding or consciousness. AI-generated texts may appear coherent and sophisticated, but they do not emerge from emotional suffering, lived experience, or human intentionality. Similarly, Bender et al. described large language models as "stochastic parrots" that reproduce patterns from datasets rather than demonstrating true creativity. Several scholars argue that AI-generated literature risks becoming repetitive and formulaic because machine- generated texts depend heavily on existing linguistic patterns. Unlike human writers, AI systems cannot genuinely feel grief, love, fear, hope, or cultural belonging. Consequently, AI-generated narratives often lack symbolic depth and emotional authenticity. Ethical concerns also dominate discussions surrounding AI-assisted writing. Educational researchers warn that AI-generated assignments may encourage plagiarism, academic dishonesty, and cognitive laziness. Questions regarding authorship, copyright ownership, and authenticity remain unresolved. The increasing normalization of AI-generated content therefore challenges traditional understandings of literary originality and human creativity. Despite these concerns, many scholars advocate a balanced approach. AI can support human writers by functioning as a collaborative tool rather than a replacement for imagination. Responsible integration of AI into literature may enhance productivity while preserving human emotional depth and creative independence.

Objectives

The growing integration of Artificial Intelligence into academic and creative writing has blurred the distinction between machine-assisted content generation and human imagination. AI-powered writing systems increasingly influence the way students and writers construct ideas, narratives, and literary expression. Although AI enhances productivity and accessibility, excessive dependence on automated writing systems may reduce originality, emotional authenticity, critical thinking, and imaginative engagement. Literature traditionally depends upon lived human experience, emotional consciousness, and creative reflection. The increasing automation of writing therefore raises concerns regarding the future of authentic literary creativity and the preservation of human imagination in the digital age.

1. To analyse the role of Artificial Intelligence in literature and creative writing.
2. To examine the relationship between AI-assisted writing and human imagination.
3. To identify the positive and negative impacts of AI-generated literary content.
4. To evaluate whether AI affects originality and critical thinking among students and writers.
5. To understand students' perceptions regarding AI-generated literature.
6. To explore the ethical implications associated with AI-assisted writing.
7. To examine the future of creative writing in the age of Artificial Intelligence.

Methodology

The study adopts a mixed methodology combining conceptual analysis and survey-based research. It involves undergraduate students aged 18–24 years to examine their use of AI writing tools and perceptions of creativity, originality, and imagination. Data is collected through questionnaires focusing on AI usage, writing habits, and dependence on digital tools. The conceptual approach critically analyzes the relationship between Artificial Intelligence and literary expression. This combined method enables both theoretical

understanding and empirical evaluation of the impact of AI-assisted writing on creativity, emotional depth, and independent thinking

Analysis

The findings indicate that AI writing tools have become deeply integrated into students' academic and creative practices. Approximately 81 percent of respondents reported regularly using AI-based writing systems for assignments, essays, summarization, grammar correction, and creative writing support. ChatGPT emerged as the most frequently used platform among participants. A significant percentage of respondents agreed that AI tools improve writing efficiency and reduce difficulties associated with idea generation. Around 67 percent believed that AI systems help overcome writer's block and increase productivity. Students appreciated the ability of AI tools to provide quick suggestions, grammatical corrections, and structural organization. However, concerns regarding originality and imagination were also highly visible. Nearly 74 percent of respondents believed that excessive dependence on AI could reduce imaginative thinking and critical reflection among students. Many participants expressed concern that constant AI assistance may encourage intellectual dependency and passive learning behaviour. Only 39 percent of respondents believed that AI-generated literature possesses emotional depth comparable to human-written literature. Participant observed that AI-generated stories often appear technically accurate but emotionally mechanical. Human experiences such as grief, cultural identity, love, trauma, and social struggle remain difficult for AI systems to authentically represent. Students strongly associated literature with emotional authenticity, symbolic meaning, and individual perspective. Many respondents argued that literature created entirely through AI systems lacks the spontaneity and unpredictability characteristic of genuine human imagination. Educational implications were also significant. Since the COVID-19 pandemic, AI tools have become normalized within digital learning environments. Although these technologies improve accessibility and support beginner writers, the absence of proper ethical guidelines may encourage overdependence on automation. Educational institutions therefore need policies promoting responsible AI usage while encouraging independent creativity and critical thinking. The findings demonstrate that Artificial Intelligence is transforming literary practices and educational writing environments. However, human imagination continues to remain central to meaningful and emotionally authentic literature.

Findings and Discussion

The emergence of generative Artificial Intelligence represents one of the most significant transformations in the history of writing and communication. AI systems have introduced unprecedented speed and accessibility into literary production. Students and writers can now generate essays, poems, stories, and articles within seconds. This transformation challenges traditional assumptions regarding authorship, creativity, and originality. One of the central debates concerns whether AI can truly create literature. AI systems generate text through statistical prediction and pattern recognition rather than emotional consciousness. Although AI-generated outputs may imitate literary style and structure, they do not emerge from lived human experience. Human creativity is shaped by emotion, suffering, memory, relationships, and cultural belonging. AI systems do not possess personal identity, emotional awareness, or subjective consciousness. Another major concern involves cognitive outsourcing. Increasing dependence on AI may gradually reduce independent imaginative engagement among students. When students rely excessively on automated systems for idea generation and writing assistance, they may spend less time engaging in

reflective thinking and creative exploration. Over time, this could weaken originality and intellectual autonomy. The ethical implications are equally significant. Questions regarding authorship and ownership remain unresolved. If an AI system generates a poem or story, who should be recognized as the creator? Additionally, AI systems are trained on massive datasets containing existing human works, raising concerns regarding copyright and intellectual property. Despite these concerns, AI should not necessarily be viewed as an enemy of creativity. When used responsibly, AI can function as a supportive collaborative tool that assists writers in brainstorming, editing, and language refinement. The challenge lies in maintaining a balance between technological assistance and imaginative independence. The future of literature will therefore depend upon how effectively society integrates AI into creative practice while preserving emotional authenticity, originality, and human imagination.

Conclusion

Artificial Intelligence has significantly transformed literature, education, and creative writing practices in the digital age. AI-powered systems provide powerful support for idea generation, grammar correction, language assistance, and productivity enhancement. For students and beginner writers, these technologies improve accessibility and reduce technical barriers associated with writing. However, the findings of this study demonstrate that excessive dependence on AI may negatively affect originality, imagination, emotional authenticity, and critical thinking. Literature fundamentally depends upon human consciousness, emotional experience, cultural identity, and imaginative reflection. Although AI systems can imitate linguistic structures and generate coherent narratives, they cannot genuinely experience human emotions or subjective reality. The study therefore concludes that AI should function as a supportive instrument rather than a replacement for human creativity. Human imagination remains irreplaceable within authentic literature. Educational institutions, writers, and researchers must encourage responsible AI integration while preserving independent thought and emotional expression. The future of literature will likely involve collaboration between human creativity and technological innovation. The challenge for modern society lies in ensuring that technological advancement strengthens rather than weakens the imaginative capacities that define human artistic expression.

Table 1: Frequency of AI Writing Tool Usage

AI Usage Frequency	Respondents	Percentage
Daily	58	48.3%
Weekly	39	32.5%
Rarely	17	14.2%
Never	6	5%

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AI in Education: Transforming Teaching and Learning

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Abstract

The Artificial Intelligence (AI), along with media and modern technology, is transforming the education system by shifting from traditional teaching methods to student-centered learning. AI tools such as virtual assistants, smart platforms, and automated systems support personalized learning based on individual student needs. Digital technologies and online platforms have made education more accessible, flexible, and engaging. While AI offers benefits like improved learning outcomes and time efficiency, challenges such as data privacy and limited human interaction remain. Overall, AI and technology have the potential to create a more effective and inclusive learning environment when used in a balanced way.

Keywords: Artificial Intelligence, Data Privacy, Online Learning Platforms, Technology, Virtual Classrooms

Introduction

Education plays a vital role in shaping individuals and developing society. In the modern world, the integration of advanced technologies has significantly transformed various sectors, including education. Among these technologies, Artificial Intelligence (AI) has emerged as one of the most powerful tools that is reshaping teaching and learning processes. AI, along with digital media and technological advancements, is bringing a revolutionary change in how knowledge is delivered, accessed, and understood. Traditionally, education followed a teacher-centred approach where students were passive recipients of knowledge. However, with the introduction of AI and modern educational technologies, the focus has shifted towards a more student-centred learning environment. AI enables personalized learning experiences by analyzing students' performance, learning speed, and preferences. This allows educators to tailor content according to individual needs, thereby improving understanding and academic outcomes. In addition, the role of media and technology has expanded significantly in education. Digital platforms, online learning systems, and virtual classrooms have made education more accessible and flexible. Students can now learn anytime and anywhere through mobile applications, educational websites, and online courses.

Review of Related Literature

The use of multimedia elements such as videos, animations, and interactive simulations has made learning more engaging and effective. AI-powered tools such as virtual assistants, chatbots, automated grading systems, and intelligent tutoring systems are helping both students and teachers. For students, these tools provide instant feedback, personalized guidance, and continuous support. For teachers, AI reduces workload by automating repetitive tasks like grading and attendance, allowing them to focus more on

teaching and mentoring. However, despite its advantages, the integration of AI in education also presents certain challenges. Issues such as data privacy, lack of human interaction, digital divide, and over-dependence on technology need to be carefully addressed. It is important to maintain a balance between technological advancement and human involvement to ensure effective learning. This paper aims to explore how AI, media, and technology are transforming teaching and learning processes. It also examines the benefits, challenges, and future possibilities of AI in education, highlighting its potential to create a more inclusive, efficient, and innovative learning environment.

According to Holmes, Bialik, and Fadel (2019), Artificial Intelligence supports personalized and student-centered learning.

UNESCO (2021) stated that AI can improve accessibility and flexibility in education when used ethically.

Luckin (2018) explained that AI technologies help improve teaching methods and student engagement.

Methodology

Type of Study

This study is based on a qualitative method. This means the research focuses on understanding ideas, concepts, and information rather than numbers or calculations.
The aim is to study how Artificial Intelligence (AI), media, and technology are changing education in a simple and clear way.

Source of Data

This study uses secondary data, which means the information is already available and collected from different sources.
The data is taken from:

- Research articles
- Books related to education and technology
- Educational websites
- Reports from organizations like UNESCO
- Online learning platforms

These sources are used because they provide reliable and useful information about AI in education.

Method of Data collection

The data is collected by reading and studying different materials related to the topic. Important points are selected and organized properly.
Only relevant and useful information is chosen to make the study clear and meaningful.

Method of Analysis

The collected data is analyzed using a simple thematic method.
This means the information is divided into different topics such as:

- Role of AI in education
- Use of media and technology
- Benefits of AI
- Challenges of AI

- Future of education

Each topic is explained separately to make it easy to understand.

Tools used in Education

This study also looks at some common AI tools used in education. These include:

- AI Chatbots – help students by answering questions instantly
- Online Learning Platforms – allow students to learn anytime
- Virtual Classrooms – support online classes
- Automated Grading Systems – help teachers in correcting papers
- Educational Apps – make learning interactive and fun

These tools help both students and teachers in the learning process.

Scope of the Study

This study mainly focuses on how AI, media, and technology are used in education.
It covers:

- Teaching methods
- Learning experiences
- Student performance
- Use of digital tools

The study does not go into technical details of how AI is created.

Limitation of the Study

This study has some limitations:

- It uses only existing information (secondary data)
- No surveys or interviews are conducted
- Some information may change as technology develops
- It does not include detailed statistics

Even with these limitations, the study gives a clear idea about AI in education.

Ethical Considerations

This study follows basic ethical rules:

- Uses information from trusted sources
- Avoids copying content directly
- Does not collect personal data

All information is used only for educational purposes.

Analysis

Role of AI in Education

Artificial Intelligence plays a very important role in modern education. It helps in improving the way students learn and teachers teach. AI systems can understand student performance and provide support based on their needs.

For example, if a student is weak in a subject, AI tools can provide extra practice and guidance. If a student is strong, the system can give advanced content. This makes learning more effective and comfortable for every student. AI also helps teachers by reducing their workload. Tasks like checking assignments, preparing reports, and tracking attendance can be done automatically using AI tools.

Personalised Learning

To ensure rigour, the study used a structured literature review process that involved three One of the biggest advantages of AI is personalized learning. In traditional classrooms, all students are taught in the same way. But not all students learn at the same speed. AI solves this problem by providing customized learning for each student. It studies the learning behaviour of students and gives content based on their level.

For example:

- Slow learners get more explanation and practice
- Fast learners get advanced topics
- Students can learn at their own pace

This improves understanding and increases student confidence.

Use of Media and Technology

Media and technology make learning more interesting and engaging. Instead of only reading books, students can now learn using videos, animations, and interactive tools.

Examples include:

- Educational videos
- Online classes
- Digital presentations
- Interactive quizzes

These methods help students understand difficult topics easily. Visual learning is more effective than only reading or listening.

Online Learning and Virtual Classrooms

Online learning has become very popular, especially after recent global changes. Students can now attend classes from home using virtual classrooms.

Benefits include:

- Learning from anywhere
- Flexible timing
- Access to recorded lectures
- Easy communication with teachers

However, students may sometimes feel less connected due to lack of face-to-face interaction.

Benefits of AI in Education

AI provides many benefits in education.

Better Learning Experience

Students understand topics more clearly through personalized support.

Time Saving

AI reduces time spent on repetitive tasks like grading.

24/7 Support

Students can get help anytime using AI tools.

Improved performance

Students perform better with continuous feedback.

Support for Teachers
Teachers can focus more on teaching instead of administrative work.

Challenges of AI in Education
Even though AI has many advantages, there are also some challenges:

a. **Data Privacy Issues**: AI systems collect student data, which must be protected properly.
b. **Lack of Human Interaction:** Too much use of technology can reduce personal communication between teachers and students.
c. **Digital Divide:** Not all students have access to internet and devices.
d. **Over Dependence on Technology:** Students may rely too much on AI and reduce independent thinking.

Impact on Students
AI has both positive and negative effects on students.
Positive Impact:

- Easy access to learning
- Better understanding
- Increased confidence
- Self-paced learning

Negative Impact:

- Reduced social interaction
- Screen time increase
- Dependence on technology

Impact on Teachers
AI supports teachers in many ways:

- Reduces workload
- Helps track student progress
- Provides teaching support tools
- Improves teaching methods

However, teachers must learn new technologies to use AI effectively.

Future of AI in Education
The future of AI in education is very bright. Technology will continue to improve learning methods,
In the future:

- AI tutors may guide students personally
- Virtual reality can create real-life learning experiences
- Education will become more digital and interactive

However, human teachers will always be important. Technology should support education, not replace teachers.

Table 1. Impact of AI, Media and Technology.

Area	Positive Impact	Negative Impact
Learning	Personalized and easy	Over Dependence
Teaching	Less workload	Need for training
Access	Learn anywhere	Digital Divide
Interaction	Online communication	Less face to face

Findings and Discussion

From the above points, it is clear that AI, media, and technology are changing education in a positive way. They make learning easier, faster, and more interesting. But at the same time, challenges must be solved. Equal access to technology and proper use of AI are important for successful learning. A balance between technology and human teaching is necessary for better education.

Conclusion

Artificial Intelligence, along with media and modern technology, is playing a transformative role in education. It has changed traditional teaching methods into more advanced, flexible, and student-centred approaches. AI-powered tools, online platforms, and digital media have made learning more accessible, interactive, and efficient. The study highlights that AI improves personalized learning, enhances student engagement, and supports teachers in managing academic tasks. At the same time, challenges such as data privacy, lack of human interaction, and unequal access to technology must be addressed carefully. It is important to use AI in a balanced way, media and technology supports teachers rather than replacing them. Human interaction, emotional intelligence, and guidance are still essential for effective learning.

In conclusion, AI and technology have the potential to create a more inclusive and innovative education system. With proper implementation and ethical use, they can significantly improve the quality and accessibility of education in the future.

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Mapping The Research Landscape of Artificial Intelligence in Design Education: A Systematic Literature Review (2016–2025)

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Abstract
This study reviews the research landscape of artificial intelligence (AI) in design education from 2016 to 2025. In recent years, AI and generative AI tools have been widely used in design learning, design thinking, creativity training, and visual communication education. However, research on AI in design education is still developing, and a clear overview of its main trends and research structure is needed. To address this gap, this study uses a literature review and bibliometric analysis approach. Publications were collected from IEEE Xplore, Web of Science, and Scopus. After keyword searching, database comparison, duplicate removal, and manual screening of titles, abstracts, and keywords, 137 journal articles were included for analysis. VOSviewer was used to conduct co-authorship and keyword co-occurrence analyses. The results show that publications on AI in design education increased rapidly after 2022, with strong growth in 2024 and 2025. The co-authorship network shows that the field is still fragmented, with several small research groups but limited cross-group collaboration. The keyword analysis indicates that “artificial intelligence,” “design education,” “generative artificial intelligence,” “students,” “teaching,” “creativity,” and “design process” are important themes. The findings suggest that AI in design education has become an emerging research area, but more studies are still needed to examine how AI supports students’ design thinking, creative processes, and visual communication practice in real learning contexts.

Keywords: AI, Design Education, Systematic Review, Vosviewer

Introduction

Artificial intelligence (AI) is developing rapidly in education, especially in design education. In recent years, AI tools have been used to support design learning, creative thinking, visual communication, and design practice. Previous studies have shown that AI can help learners interact with digital learning environments and improve their learning engagement and learning performance (Hwang et al., 2022). Generative AI tools, such as ChatGPT, DALL-E, and Midjourney, have also become useful tools in design education. These tools can support knowledge learning, idea generation, visual exploration, and personalized learning support (Tsiydlo & Chele, 2023; Yin et al., 2023). However, the use of AI in design education also raises important concerns. Some researchers have pointed out that students may become too dependent on AI tools. If

students rely too much on AI-generated results, their design thinking, creativity, and critical thinking may be weakened (Chen & Liu, 2023; Jin et al., 2024; Zawacki-Richter et al., 2019). In design education, students need to understand problems, develop ideas, make design decisions, and reflect on their creative process. Therefore, AI should not be seen as a replacement for human creativity. Instead, it should be used as a supporting tool that helps students learn, think, and create.

AI has been applied in many areas of design education, including concept learning, design thinking training, creativity development, and collaborative creation. For example, AI-supported systems may help students improve their flow experience during collaborative creative work and support higher-level design thinking (Díaz-Rodríguez et al., 2023). In addition, AI can process large amounts of information and help students explore design problems from different perspectives. This may provide new opportunities for design learning and creative problem solving. However, researchers have also warned that AI-driven design environments need careful instructional design. If teachers do not guide students properly, AI may reduce students' active participation and deep thinking in the design process (Verhulsdonck et al., 2021; Lee et al., 2023).

Objectives

For this reason, it is important to review how AI has been studied and applied in design education. Although the number of studies has increased in recent years, this research area is still developing. There is still a need to understand its publication trends, major research themes, author collaboration patterns, and research gaps. A clearer overview of the field can help design educators understand how AI is being used in design learning and what issues still need further study. Therefore, this study reviews the research landscape of AI in design education from 2016 to 2025. It collects related journal articles from IEEE Xplore, Web of Science, and Scopus, and uses bibliometric analysis to examine publication trends, co-authorship networks, and keyword co-occurrence patterns. Through this analysis, the study aims to identify the main development trends, important themes, and future research directions of AI in design education. The findings can provide useful references for design educators, curriculum designers, and researchers who are interested in AI-supported design learning.

Methodology

This study used a literature review and bibliometric analysis approach to examine the research landscape of artificial intelligence in design education from 2016 to 2025. Bibliometric analysis is useful for reviewing many publications and identifying the development of a research field, including publication trends, research themes, and collaboration patterns (Donthu et al., 2021). Therefore, this approach was suitable for this study because AI in design education has grown rapidly in recent years, but its research structure still needs to be better understood. The data were collected from three academic databases: IEEE Xplore, Web of Science, and Scopus. These databases were selected because they cover different but related research areas. IEEE Xplore includes many studies in engineering, computing, and educational technology. Web of Science and Scopus are widely used citation databases, but their journal coverage is not exactly the same (Mongeon & Paul-Hus, 2016). Therefore, using more than one database can help reduce the limitation of using a single source. It can also help this study collect a broader and more reliable set of publications. In addition, previous research has suggested that academic search systems differ in their retrieval functions and search quality, so

researchers should carefully choose suitable databases and use clear search strategies (Gusenbauer & Haddaway, 2020). The search focused on studies related to artificial intelligence and design education. The main search terms included “artificial intelligence,” “generative AI,” “LLM,” “chatbot,” “intelligent agent,” “design education,” “design pedagogy,” “design studio,” “design teaching,” “design curriculum,” “art,” “creativity,” “design thinking,” and “learning outcomes.” These keywords were combined with Boolean search strategies to identify relevant publications. The initial search found 61 records from IEEE Xplore, 63 records from Web of Science, and 453 records from Scopus. In total, 577 records were collected at the first stage.

To improve the quality of the dataset, this study did not directly use all initial search results. Instead, a multi-stage screening process was conducted. First, only English journal articles were included, while conference papers and other document types were excluded. Second, duplicated records were removed by checking DOI, title, author names, and publication year across the three databases. Third, the titles, abstracts, and keywords of the remaining articles were reviewed manually. Articles were excluded if they included words such as AI, design, or education but were not actually related to design education. This manual checking process helped reduce irrelevant records and made the dataset more focused on the design education context. After these screening steps, 137 journal articles were included in the final dataset. These articles were used for further bibliometric analysis. VOSviewer was used to analyze co-authorship networks and keyword co-occurrence patterns. VOSviewer is a commonly used tool for constructing and visualizing bibliometric maps, and it is especially useful for showing relationships among authors, keywords, and research topics (van Eck & Waltman, 2010). Through this process, this study identified the main research structure and development direction of AI in design education.

Overall, the data collection process was not a one-time search. It included keyword design, database searching, document type screening, duplicate removal, manual topic checking, and bibliometric mapping. This process helped improve the quality of the final dataset and made the analysis more focused on AI applications in design education.

Analysis

Publication Trends from 2016 to 2025

The first part of the analysis examines the annual publication trend of AI-related research in design education from 2016 to 2025. Based on the final dataset of 137 journal articles, the number of publications was very limited before 2022. From 2016 to 2021, only one paper was identified in 2019, while no relevant articles were found in the other years. This result shows that AI in design education had not yet become a major research topic during this early period. A clear increase can be observed from 2022 onward. In 2022, the number of publications increased to eight papers. This suggests that researchers had begun to pay more attention to the role of AI in design education. This trend is also consistent with the broader development of AI in education. Previous studies have shown that AI-supported learning and online learning research have increased in recent years, especially in relation to intelligent learning systems, personalized learning, and educational technology (Hwang et al., 2022; Zawacki-Richter et al., 2019).

In 2023, which was an important year for the rapid development of generative AI, the number of publications rose to 15 papers. This growth may be related to the wider use of

large language models and generative AI tools in education. Kasneci et al. (2023) pointed out that large language models can support learning, teaching, feedback, and content generation, but they also require careful educational design. Therefore, the growth after 2023 may reflect not only the popularity of AI tools, but also the increasing need to understand their educational value and possible risks.

The growth became even more obvious in 2024, with 30 papers published. This increase may be related to the wider use of AI tools in creative practice, design learning, and design curriculum development. In 2025, the number of publications reached 83 articles, accounting for the largest proportion of the dataset. Although the publication trend in 2025 should be interpreted carefully, the sharp increase still shows that AI in design education has become an important and fast-growing research topic. The publication trend suggests that AI research in design education has moved from an early stage to a period of rapid growth. This result also reflects a larger change in education. AI is no longer discussed only as a technical tool. It is increasingly connected with learning support, teaching design, creativity development, and curriculum innovation. However, as Chen et al. (2020) suggested, AI education research still needs stronger links between AI technologies and educational theories. This point is also important for design education, because design learning is not only about using tools, but also about developing thinking, judgment, and creativity.

Co-authorship Network Analysis

The second part of the analysis examines the author collaboration network of AI research in design education. VOSviewer was used to conduct a co-authorship analysis. The unit of analysis was authors, and the counting method was full counting. From the 137 journal papers, a total of 475 authors were identified. To focus on more active contributors, the minimum number of publications per author was set at two. Based on this threshold, 38 authors were included in the final co-authorship network. Of these 38 authors, 47% were from China, 20% from Malaysia, and 11% each from the United States and Turkey. As shown in Figure 1, the co-authorship network is relatively scattered and consists of several small clusters. Although some authors have clear collaborative relationships, many groups are weakly connected with each other. VOSviewer also shows that the largest connected group includes only 10 authors. This result suggests that AI research in design education has not yet formed a highly centralized research community.

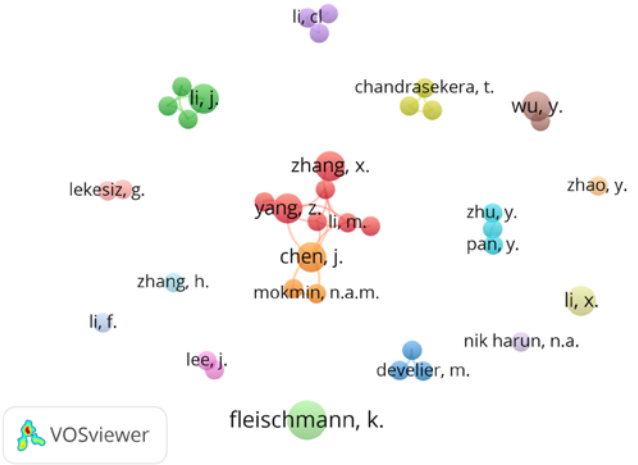

Figure 1: Subsets of AI

In the central part of the network, some authors, such as yang, z., zhang, x., li, m., chen, j., and mokmin, n. a. m., show more visible collaborative links. These authors may be regarded as part of a local collaboration core within the dataset. However, most other authors are located in smaller groups or isolated positions. This means that current research on AI in design education is still mainly developed by individual research teams or small collaborative groups. This scattered pattern also shows that AI in design education is still an emerging interdisciplinary field. Researchers may enter this field from different backgrounds, such as design education, educational technology, computer science, human-computer interaction, and creativity studies. This situation is like the broader development of AI in education, where researchers have explored AI from different technical and pedagogical perspectives (Chen et al., 2020; Hwang et al., 2022). However, in design education, stronger collaboration is still needed to build a more stable research community.

Findings and Discussion

The co-authorship network indicates that future studies may benefit from stronger cross-disciplinary and cross-national cooperation. For example, design educators can work with AI researchers to design more suitable AI-supported design learning environments. Educational technology researchers can help evaluate learning processes and learning outcomes. Human-computer interaction researchers can help improve the usability and learning experience of AI tools. Such collaboration could help the field develop a more integrated theoretical foundation and a clearer research direction.

Keyword Co-occurrence Analysis

The third part of the analysis focuses on keyword co-occurrence. The type of analysis was co-occurrence, the unit of analysis was keywords, and the counting method was full counting. From the 137 journal articles, a total of 799 keywords were identified. To focus on more important and repeated terms, the minimum number of keyword occurrences was set at five. Based on this threshold, 29 keywords were included in the final network, as shown in Figure 2. As shown in Figure 2, “artificial intelligence” and “design education” are the two most central keywords in the network. This result indicates that AI and design education form the main research focus of this field. These two keywords are closely connected with other terms, such as “students,” “teaching,” “learning,” “creativity,” “generative artificial intelligence,” “product design,” and “visual communication design.” This finding shows that current studies do not only discuss AI as a technology. They also examine how AI is used in design courses, student learning, teaching practice, and creativity development.

The cluster structure in Figure 2 shows several main research directions. First, “artificial intelligence” and “design education” are located at the center of the network. Their larger nodes and stronger links show that they are the main knowledge focus in this group of studies. Second, “generative artificial intelligence” is connected with “design process,” “product design,” and “design education.” This means that generative AI has gradually become a more specific research topic. It is no longer discussed only as a general AI issue but is increasingly connected with design processes and design teaching. This result is supported by recent studies on generative AI and design practice. For example, Yin et al. (2023) examined how Midjourney can be integrated into design systems and support future-oriented design innovation. Jin et al. (2024) also showed that generative AI tools can support early-stage design ideation and revision by providing rapid visual stimuli. These

studies suggest that generative AI may influence not only the final design outcome, but also the way designers generate, compare, and refine ideas.

Third, the cluster on the lower-left side includes keywords such as “students,” “teaching,” “curriculum,” “learning,” and “creativity.” This cluster shows that many studies are concerned with how AI affects student learning, instructional design, curriculum planning, and creativity development. For design education, this is an important direction because AI may influence not only the final design outcome, but also how students understand problems, develop ideas, and make design decisions. Fourth, the upper-left part of the network includes “visual communication design,” “design,” and “visualization.” This suggests that visual communication design and visualization have become important professional areas in AI-related design education research. However, compared with “artificial intelligence” and “design education,” “visual communication design” is still not a central keyword in the whole network. This means that visual communication design has received attention, but it has not yet become a major research focus in this field. Fifth, the right side of the network includes keywords such as “Midjourney,” “interior design,” and “interior design education.” This indicates that generative image tools and their applications in specific design fields are gaining more attention. These keywords also show that AI research in design education is moving from general discussion to more concrete design domains and practical teaching contexts.

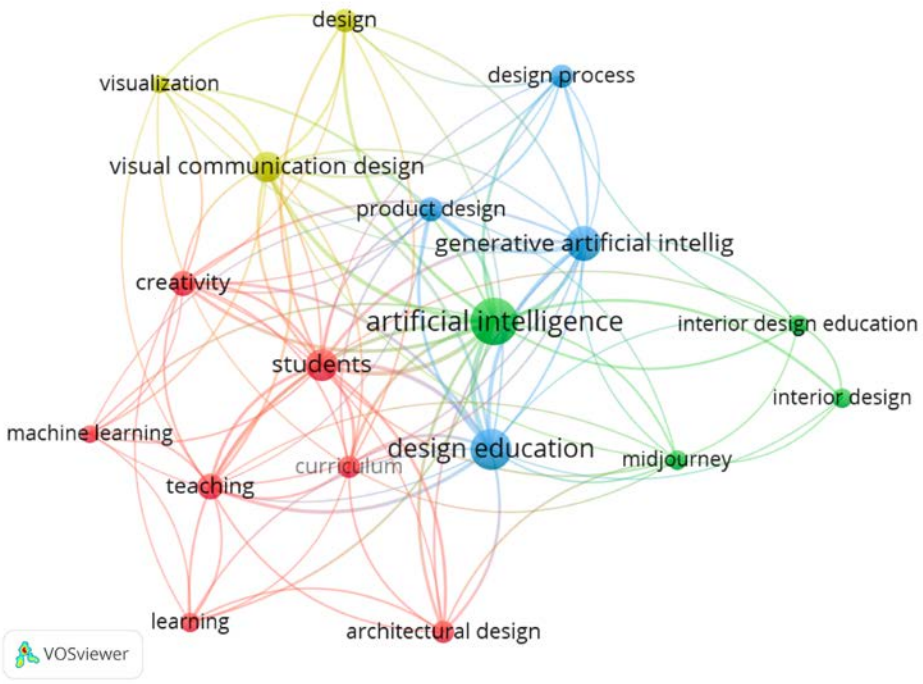

Fig 2: Keyword Analysis

This study reviewed the research landscape of artificial intelligence in design education from 2016 to 2025. Based on 137 journal articles collected from IEEE Xplore, Web of Science, and Scopus. The results show that AI in design education is not yet a fully mature research field, but it is becoming an important and fast-growing research area. The publication trend shows that research on AI in design education increased rapidly after 2022. This growth may be closely related to the wider use of generative AI tools in education and creative practice. AI is no longer discussed only as a technical tool. It has

gradually become connected with design learning, teaching practice, creativity development, design process, and curriculum design. The co-authorship analysis shows that the research community is still relatively fragmented. Although some small research groups have already formed, collaboration among different groups, institutions, and countries remains limited. This suggests that AI in design education is still in an early stage of academic development. Future studies may need stronger cross-disciplinary collaboration among design education, educational technology, artificial intelligence, human-computer interaction, and learning sciences.

Conclusion

The keyword co-occurrence analysis further shows that “artificial intelligence,” “design education,” “generative artificial intelligence,” “students,” “teaching,” “creativity,” and “design process” are important themes in this field. These keywords indicate that current research has started to move from general discussions of AI tools to deeper educational issues. Researchers are now paying more attention to how AI influences students’ learning, creative thinking, design decision-making, and teaching practice. However, the findings also show some important research gaps. Although creativity has appeared in the keyword network, it has not yet become the strongest central concept. This means that many studies may still treat creativity as a learning outcome, rather than examining how creative ideas are formed, revised, and judged during the design process. In addition, visual communication design has received attention, but it is still not a core theme in the overall network. This suggests that more research is needed to explore how AI affects concept development, visual expression, image translation, and communication in visual design education. Therefore, the contribution of this study is not to claim that AI has completely changed design education. Instead, this study shows that the field is now at a stage where the main research themes are becoming clearer, but many detailed learning processes still need further study. Future research should not rely only on bibliometric maps. It may also include course observations, student work analysis, interviews, and design process data. These approaches can help researchers better understand how students use AI in real design learning contexts.

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The Effectiveness of Using Generative Artificial Intelligence (AI) as Conversation Partner in Developing Conversation Skills among English as Foreign Language Students in Al-Mergib University

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Abstract

As a result of Generative AI technology, especially Generative AI language models such as ChatGPT, there have been many advances in the area of language acquisition through the provision of numerous interaction opportunities that learners can benefit from when learning a language. There are various factors contributing to the difficulties faced by the learners of English as a foreign language in Al-Mergib University, which include. Therefore, the current systematic literature review was intended to examine the impact of Generative AI systems used as conversational partners on EFL students' speaking skills and FLCA. The current review has explored previous empirical studies and reviews that have addressed the issue of AI-assisted speaking classes, chatbots as educational tools, and affective issues in language acquisition. It was discovered that conversational AI technologies were beneficial for the development of fluency in speaking, pronunciation skills, grammatical accuracy, conversational abilities, and confidence in students. It is crucial to understand that students who were using conversational AI technologies had better outcomes compared to those who used traditional methods of education. In addition, the application of AI-assisted learning helped to reduce students' speaking anxiety due to the possibility to have flexible conversations without fear of judgment. Although there are many positive aspects related to the implementation of AI in education, several concerns still need to be considered, including ethics, technical questions, teachers' inability to work with these technologies, and insufficient emotional intelligence.

Keywords: Conversational Practice, English Language Learning, EFL Speaking Skills, Foreign Language Speaking Anxiety, Generative Artificial Intelligence

Introduction

Remarkable developments in AI technology have significantly impacted global educational processes, particularly in English language education. The emergence of generative AI and large language models like ChatGPT has enabled natural human-machine interactions, creating new learning opportunities through practical interactions and immediate feedback. Speaking skills are vital components of communicative competence, yet EFL learners face considerable challenges in mastering oral communication, especially in English language minority environments. These barriers include vocabulary and grammatical difficulties, weak pronunciation, low self-confidence, and fear of making mistakes.

In Libya, particularly at Al-Mergib University, English language teaching remains primarily teacher-centered and grammar-based, emphasizing memorization, translation, and examinations rather than communication. Large classes, limited technology use, and lack of real-life English exposure further hinder speaking skill development. Additionally, Foreign Language Speaking Anxiety (FLSA) represents a significant obstacle, described as intense fear and psychological distress experienced when speaking a foreign language. This systematic review examines the effectiveness of using Generative AI as a conversational partner to develop conversation skills among EFL students at Al-Mergib University, providing the theoretical groundwork for ongoing doctoral research.

The present systematic review is conducted within the framework of an ongoing PhD research project under the title: " **The Effectiveness of Using Generative Artificial Intelligence (AI) as Conversation Partner in Developing Conversation Skills Among English as Foreign Language Students in Al-Mergib University".** This review provides the theoretical groundwork for the empirical stage of the doctoral research, which remains in progress.

Review of Related Literature

There have been remarkable developments in the application of AI technology which have had an immense impact on educational processes across the globe, particularly in the case of English language education. One of the most remarkable developments of the recent past has been the emergence of generative AI and LLMs like ChatGPT which make possible the possibility of natural interactions between people (Javaid et al., 2023). The emergence of such technologies has paved the way for new ways of learning in which learners can benefit from practical interactions and immediate feedback (Almogren et al., 2024). In particular, EFL learning contexts have seen these conversational AIs as valuable learning tools which can improve students' speaking skills while overcoming limitations posed by traditional classroom learning settings (Chen et al., 2022).

It should be mentioned that speaking skills are considered among those vital components of communicative competence that help learners express their thoughts, exchange them effectively, and become successful in communication in academic and social settings. As follows from the key ideas of communicative language teaching principles, learning becomes effective because it is based on engagement and participation in authentic language use in interaction and real communicative situations (Yan et al., 2024). It is significant that mastering speaking skills turns out to be quite a challenging task that English as a Foreign Language (EFL) learners have to cope with, especially when learning in English language minority environments. Speaking is hampered by different barriers, including vocabulary and grammatical difficulties, weak pronunciation, low self-confidence, and fear of making mistakes in oral communication (Akiba, 2025).

In Libya, the issue appears especially difficult with regard to higher education institutions, such as Al-Mergib University, where even today, English language teaching remains primarily teacher-centered and grammar-based. The teaching process tends to involve memorizing, translating, and taking exams, but not communicating (Chen et al., 2022). Moreover, large classes, low technology use, and lack of real-life English language exposure create difficulties in achieving sufficient speaking skills in English (Zhai &

Wibowo, 2022). In consequence, many EFL students in Libya obtain a university degree having never acquired sufficient oral skills (Özdemir & Seçkin, 2024).

An additional important problem that exists in EFL learner's education is called Foreign Language Speaking Anxiety (FLSA). Speaking anxiety may be described as an intense feeling of fear, nervousness, and psychological distress experienced by the students while speaking in a foreign language. As a result of these difficulties, various innovative artificial intelligence technologies have been created as effective means for language acquisition. For instance, platforms like ChatGPT, ELSA Speak, Duolingo, and Speechace offer learners the chance to improve their speech skills within flexible, stress-free, and personalized conditions. The main advantage of using AI technologies in language learning is that students are provided with opportunities to communicate freely without any risks of being criticized or ridiculed (Alamri & Qasem, 2024).

Several recent studies carried out internationally have demonstrated the positive influence of AI conversational agents on learners' language acquisition performance. It has been noted that AI chatbots can increase learners' speaking fluency, pronunciation skills, use of vocabulary, motivation, and confidence levels. In addition, AI tools help to foster autonomous learning since learners can learn on their own at any time and from any place according to their own schedule. Although all the above benefits are evident in several research, it should be noted that almost all of them were done in technologically developed educational systems in such countries as China, South Korea, Japan, and the United States (Vo, 2025).

Moreover, there are existing studies which examined either speaking proficiency or anxiety separately without taking into account how these two variables interact with each other. There have been no mixed methodological approaches which integrate quantitative measures to examine speaking proficiency together with the qualitative aspect of exploring the views of the learners as well as the teacher regarding the use of AI technology in language teaching. Thus, a significant gap in the current body of literature is the perceptions of Libyan EFL learners and teachers about AI tools for language teaching and learning (Wang et al., 2025).

Objectives

The purpose of this study will be to fill this gap through the examination of the effects of employing Generative Artificial Intelligence as an interactive conversation companion on the conversation skills acquisition process among EFL students at Al-Mergib University. The application of artificial intelligence in teaching English as a Foreign Language has received increasing interest among researchers and language teachers around the world. The application of artificial intelligence in English language learning has gained importance due to various advantages it provides in terms of learner interaction, learner autonomy, and feedback personalization (Chen et al., 2022). The use of chatbots and language models in language learning represents one of the greatest applications of artificial intelligence in language education. These systems make use of NLP and machine learning algorithms to simulate conversations (Javaid et al., 2023).

Oral fluency and accuracy represent key elements of oral proficiency. Although fluency is concerned with the flow and continuity of language production, accuracy refers to the correct use of grammar, pronunciation, and vocabulary (Wang et al., 2024). As seen from the existing literature, it has been established that the utilization of artificial intelligence

technology for oral communication leads to improved fluency and accuracy because of the numerous opportunities for practicing and correcting errors. Thus, for instance, Zhang (2025) discovered that those learners who made use of AI conversational platforms had greatly improved their pronunciation and grammatical accuracy. The issue of Foreign Language Speaking Anxiety (FLSA) is another concern mentioned in academic literature (Liu, 2023). While literature has become plentiful, still there is a shortage of studies that look into the efficiency of the use of Generative AI in Libyan universities. Previous research have mainly focused on technology-enabled contexts of education, and very few have paid attention to the way learners and instructors in underdeveloped countries view the use of AI in language classes (Vo, 2025). In addition, there is almost no empirical study carried out to find out the cumulative impact of these AI applications on speaking performance and anxiety.

Methodology

Research Design and Approach

The research adopted a systematic review methodology in order to find out the impact of Generative Artificial Intelligence (AI) as a conversational agent in building conversational competence of learners in English language. The study used qualitative as well as quantitative synthesis methodology through reviewing past empirical work that was done on the topic of AI-based language learning, conversational abilities, conversational anxiety, and attitudes of the learner. Only those peer-reviewed journal articles, conference papers, and reports were included in the literature review that were published from 2019 to 2026 (Creswell & Creswell, 2022).

Population

The population of this study was limited to published works and scholarly literature related to EFL learners, English language teachers, and AI-enabled speaking activities in higher education environments. Special attention was paid to those studies that had been carried out with EFL learners at university level, including case studies from higher education institutions in Middle Eastern countries, Asia, and Africa. Literature related to generative AI technologies, which includes large language models, chatbots, and AI conversation applications, was reviewed for this study. Any literature that did not concern speaking activities, AI-enabled interaction, or higher education environments was not considered for this study.

Data Collection

The data for the study were systematically collected from various academic databases, namely Google Scholar, Scopus, and ScienceDirect. Some of the keywords used in searching included "Generative AI," "AI conversational partner," "EFL speaking skills," "speaking anxiety," and "large language models in language learning." As an inclusion criterion, articles had to be written in English and be relevant to the topic of the study, while at the same time being peer-reviewed.

Analysis

Data Analysis

The data gathered from these studies were then analyzed through thematic and comparative methods to determine the key findings and themes that emerge from each study. The researchers classified the findings according to various categories, such as speaking fluency, speaking accuracy, learners' anxiety, teachers' attitude, and students'

perception of the use of artificial intelligence in conversation. Statistical differences of quantitative findings obtained in prior studies were also compared to find out the significant improvements achieved by incorporating artificial intelligence in speaking skills development.

Ethical Standards

Ethical considerations have been strictly maintained during this systematic review through proper citation and referencing of all sources and scholarly works that were examined. The authors did not use any kind of plagiarism in this review, because all sources were paraphrased and referenced in accordance with academic writing standards. To ensure the credibility of findings, only credible and peer-reviewed scholarly literature was included in this review. In addition, the review has been done without any kind of manipulation of collected data.

Findings and Discussion

The flow chart shown in figure 1 below outlines the process of selecting relevant articles for this systematic review based on a review methodology framework. In total, 1,189 sources were initially gathered during a search process. However, many papers were already omitted prior to the screening stage owing to the presence of duplication, irrelevancy of abstract, problems with correlation, as well as titles of articles that had nothing to do with the research theme. At the end of the screening stage, 370 records were left, while 338 articles were discarded as irrelevant. Moreover, 32 papers were selected for collection but only 26 papers were successfully retrieved. Eventually, 18 papers were excluded from the analysis due to a lack of statistical outcomes and empirical data, thus, 8 papers were included in the systematic review. The presented process indicates that a methodical approach was implemented throughout the article selection.

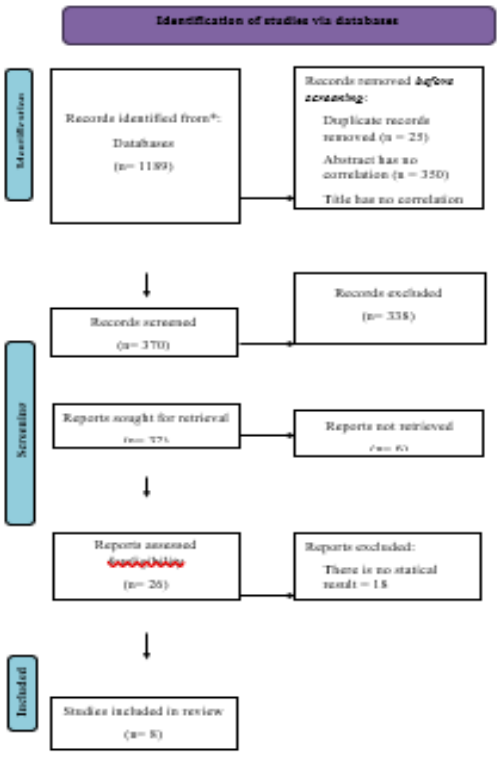

Figure 1. Literature Screening Results

Table 1 demonstrates the general features of the selected articles for the systematic review analysis. As per the findings, it is evident that the selected articles are carried out through various educational scenarios such as Saudi Arabia, Indonesia, Vietnam, among others. The methodological designs used by researchers for the studies include quasi-experiments, experiments, survey-based, meta-analysis, participatory action research, systematic review, and concept review studies. The selection of various types of research designs highlights the significance and academic interest towards AI-enabled language learning. The participants included secondary school students, undergraduate students, and even graduate-level students. The main area of interest related to AI includes chatbots learning, development of conversation skills, perception of learners, emotional aspects, and integration of ethics in AI.

Table 1. Summary of Reviewed Studies

Authors and Year	Country	Research Design	Participants	Main Focus
Alenezi & Alenezi (2025)	Saudi Arabia	Quasi-experimental	30 secondary students	Chatbot-assisted English conversation learning
Saarela et al. (2026)	Multiple countries	Meta-analysis	51 studies	Effects of GenAI on language proficiency
Lyu et al. (2024)	Multiple countries	Meta-analysis	31 studies	Chatbot effectiveness in L2 learning
Satiti et al. (2024)	Indonesia	Survey research	95 university students	Student perceptions toward AI chatbots
Minh & Khanh (2024)	Vietnam	Experimental study	28 university students	AI tools for conversational skills
Aladsani (2025)	Saudi Arabia	Participatory action research	Postgraduate students	Ethical integration of GenAI
Marzano (2025)	Multiple countries	Systematic review	197 studies	GAI in teaching and learning
Xiao et al. (2024)	Multiple countries	Conceptual review	Previous empirical studies	Emotional effects of AI chatbots

It is evident from Table 2 that Generative AI and chatbots facilitate the enhancement of speaking skills in EFL students. Most of the conducted studies show positive results in terms of gains made by learners in speaking competence, fluency, conversational ability, and even learner self-confidence as a result of AI-based conversation. For example, according to Alenezi and Alenezi (2025), the experimental group scored a significant gain in speaking competence, which was equal to 5.24 with a low p-value of less than 0.001. Also, as Lyu et al. (2024) point out, there was a statistically moderate effect size in favor of chatbot-assisted learning. Likewise, it was noted that the experimental group showed better fluency and ability to interact in conversations compared to their peers in the control group.

Table 2. Effects of AI on Speaking Skills Development

Study	Major Findings	Statistical Results
Alenezi & Alenezi (2025)	AI chatbot improved speaking competence and learner confidence	Mean gain = 5.24, $p < 0.001$
Saarela et al. (2026)	GenAI tools showed strong positive effects on language proficiency	Large statistically significant effects
Lyu et al. (2024)	Chatbots produced moderate improvement in L2 learning	$g = 0.608$, $p < 0.001$
Minh & Khanh (2024)	Students improved fluency, clarity, and conversational engagement	Experimental group outperformed control group
Satiti et al. (2024)	Students perceived chatbots as useful for improving English skills	High satisfaction scores
Marzano (2025)	GAI personalized learning and enhanced student motivation	Positive educational outcomes identified

According to Table 3, both the learners and the teachers share positive perceptions regarding the incorporation of the AI-powered chatbot in the language learning process. The participants felt motivated, confident, satisfied, and engaged when communicating with the AI chatbot due to the instant feedback, flexibility in practicing the language, and the non-threatening environment. In addition, the researchers and teachers noted increased student engagement, spontaneity, adaptability, and learner autonomy during the speaking activity assisted by AI technology. It is worth noting that some scholars emphasized the role of the AI technologies in developing critical thinking and AI literacy skills of the learners. However, the educators stressed the need for teacher preparation and professional development in implementing Generative AI technologies.

Table 3. Students' and Teachers' Attitudes Toward AI-Based Conversational Tools

Study	Students' Attitudes	Teachers'/Researchers' Observations
Alenezi & Alenezi (2025)	High motivation, confidence, and satisfaction	Students were more engaged and spontaneous
Satiti et al. (2024)	Students found chatbots user-friendly and helpful	AI supports independent learning
Minh & Khanh (2024)	Students showed greater adaptability and participation	AI expanded conversational opportunities
Aladsani (2025)	Students developed AI literacy and critical thinking	Ethical AI integration is necessary
Marzano (2025)	Positive learner engagement and motivation	Teachers require continuous AI training
Xiao et al. (2024)	Reduced anxiety and increased learner independence	Emotional dimensions must be considered

As can be seen from Table 4 below, there are several challenges and limitations regarding the integration of AI technologies in language learning. In particular, one of the main drawbacks of using chatbots in EFL contexts, according to various researchers, is their lack of emotional awareness, which may decrease the authenticity of communication between humans. The use of such tools is also hindered by ethical problems, privacy concerns, lack of training for teachers and, finally, unequal access to AI technologies. On top of that, according to the results of the reviewed studies, the efficiency of using chatbot-assisted learning is also affected by the learners' cultural background, learning environment, and other factors. However, despite all the aforementioned challenges and difficulties, various ways of addressing them have been suggested, such as creating culturally adapted chatbots, providing adequate support and training for educators, and developing ethical competencies in AI.

Table 4. Challenges and Limitations of AI-Based Language Learning

Study	Challenges Identified	Suggested Solutions
Xiao et al. (2024)	Limited emotional awareness and lack of human interaction	Develop culturally sensitive chatbots
Marzano (2025)	Lack of teacher training and ethical concerns	Provide ICT and AI training programs
Aladsani (2025)	Ethical and legal concerns regarding GenAI use	Develop ethical AI competencies
Minh & Khanh (2024)	Limited popularity and accessibility of AI tools	Increase institutional support
Lyu et al. (2024)	Variability in chatbot effectiveness	Improve accessibility and adaptability
Saarela et al. (2026)	Effects differ across learning contexts	Tailor AI integration to learner needs

Discussion Of The Effectiveness Of Using AI-Based Large Language Models As Conversational Partners In Developing Overall Oral Communication Skills Among EFL Students

According to the results from the systematic review, the application of AI-based large language models for conversations has led to increased speaking competencies among EFL students. The studies mentioned in Table 2 showed significant benefits in speaking competencies, conversational involvement, fluency, and self-confidence following the integration of AI-enabled speaking tasks. As an example, Alenezi & Alenezi (2025) identified a significant increase in speaking competency in the experimental group with a mean gain score of 5.24 ($p < 0.001$). Another study conducted by Lyu et al. (2024) highlighted the beneficial effects of chatbot-enabled learning with a moderate positive impact on second language acquisition ($g = 0.608$, $p < 0.001$). Likewise, Minh & Khanh (2024) noted improvements in learners' fluency, clarity in conversations, adaptability, and engagement following the incorporation of tools such as Call Annie and Praktika in their speaking sessions.

The findings resonate well with the previous studies highlighting the pedagogical significance of the conversation AI technology in a language learning setting. Based on Pituxcoosuvarn et al. (2025), the creation of simulated real-world conversations via AI contributes significantly towards improved pronunciation, use of proper vocabulary, grammar, and fluency in speaking. Similarly, Wei (2023) posited that conversing with an AI chatbot promotes greater communicative competence because of its capability to promote active engagement and provide learners with immediate feedback. Moreover, the findings corroborate with the previous studies reflected in Table 1 showing the growing recognition of AI-based research on language learning at an international academic level, covering a range of settings, such as Saudi Arabia, Indonesia, Vietnam, and many other countries. Finally, the findings also coincide with the social constructivist theory of language acquisition by Vygotsky, according to which AI served as an effective conversation partner that facilitated learning through interaction and scaffolded practices.

Discussion Of The Differences In Speaking Fluency And Accuracy Between The Experimental Group And The Control Group In The Post-Test

Systematic review results showed statistically significant differences between the level of speaking fluency and accuracy among experimental and control groups of students after the intervention. Students practicing speaking with the help of AI-enabled conversation apps made more progress in terms of pronunciation, sentence construction, vocabulary utilization, and grammar than students learning through traditional classroom education methods. As can be seen from Table 2, Minh & Khanh (2024) reported that students in the experimental group performed better than those in the control group in speaking fluency, flexibility, and clarity after using AI tools. Likewise, Saarela et al. (2026), after a meta-analysis of the use of Generative AI in learning, found statistically significant results indicating that AI enabled large improvements in language production skills such as speaking. It appears that AI-based conversation practice provides learners with an environment where they can practice oral communication repeatedly and without time constraints.

The above results are consistent with the existing literature, which demonstrates that AI technologies contribute to the improvement of speaking skills due to constant exposure to comprehensible input and interactions. According to Lu et al. (2026), AI technologies contribute to the development of pronunciation, grammatical structures, and vocabulary usage by immediately correcting learners' mistakes and repeating conversations. Vo et al. (2025) showed that learners participating in AI environments obtained significantly higher scores on speaking tests compared to peers who only utilized conventional approaches to education. The current findings are in line with the research conducted by Marzano, which shows that Generative AI technologies personalize the learning experience and boost student motivation. In theory, these results can be explained by Krashen's Input Hypothesis, which states that comprehensible input and meaningful interaction are crucial for second language acquisition.

Post-Intervention Speaking Anxiety Comparison

Results from the study review further revealed that learners who engaged in conversation using AI chatbots had lower levels of anxiety about speaking than students in conventional educational settings. According to the reviewed literature, AI-assisted conversation offered an encouraging atmosphere for learners, which made them feel confident enough to engage in conversations without fear of embarrassment or criticism. As illustrated in Table 3, Xiao et al. (2024) noted that AI chatbots not only helped reduce

learner anxiety but also improved learner independence and emotional comfort in language interactions. Likewise, Alenezi & Alenezi (2025) revealed that learners who conversed through AI chatbots were more motivated and satisfied than their counterparts in traditional learning settings.

The explanation for the decreased anxiety related to speaking skills lies in the versatility and privacy of AI-supported speech practice. Contrary to real-life conversations in the classroom, AI systems provide opportunities for practice sessions without any constraints or limitations. These results corroborate with the study by Demir and Kan (2025) where the researchers stated that AI-supported communication platforms reduce speaking anxiety due to the provision of psychologically safe learning environments. Moreover, the research conducted by Lee (2026) showed that the AI interaction made students feel confident when performing English-speaking tasks. The results obtained are consistent with Krashen's Affective Filter Hypothesis, according to which low-anxiety environments are conducive to effective language learning.

Discussion of the Attitudes of EFL Teachers in Libyan Universities Toward Integrating Generative AI Technologies into Speaking Instruction

As can be seen from the above-reviewed studies, EFL teachers tended to show positive attitudes regarding the incorporation of Generative AI technologies in speaking classes. The results obtained in Table 3 suggest that teachers and researchers witnessed enhanced student engagement, participation, flexibility, and independence when using AI technologies for speaking exercises. For instance, Marzano (2025) stressed that AI technologies help motivate students and personalize their learning process. Aladsani noted the necessity of teaching AI literacy, critical thinking skills, and ethics to both students and educators. Speaking AI technologies can help supplement class lessons and provide learners with extra chances to practice speaking outside class time, which is especially important for EFL learners who lack authentic speaking experience.

These results are consistent with the study conducted by Vo et al. (2025), which found that instructors regarded AI as an efficient means of promoting independent learning and increasing student engagement in speaking tasks. However, there are certain issues associated with the use of AI in higher education institutions in Libya. As can be seen in Table 4 below, teachers had reservations concerning the lack of adequate technological infrastructure, professional skills, ethics, and overreliance on technology. According to Marzano, continuous training in ICT and AI is crucial for teachers. Furthermore, Aladsani (2025) noted the need for ethical integration of AI in the context of education. Also, Boustani et al. (2024) claimed that successful integration of AI into language education involves institutional support, internet availability, and teacher preparation. In conclusion, even though the majority of instructors have a positive attitude towards AI integration, there are certain obstacles that should be overcome.

Attitudes and Challenges of AI Tools

Results from the systematic review have shown that learners' attitudes towards the utilization of AI-based conversational platforms for speaking were mainly positive. From the results presented in Table 3, learners noted that they felt motivated, more engaged, confident, and satisfied when communicating with AI chatbots. Satiti et al. (2024) observed that students found AI chatbots to be easy to use, supportive, and effective in enhancing English language skills. Additionally, Alenezi and Alenezi noted that learners became more spontaneous and engaged when practicing speaking. Similarly, Minh &

Khanh (2024) noted that learners exhibited greater adaptability and conversational skills when communicating with AI chatbots. These results imply that AI-based conversation platforms foster learner autonomy by enabling learners to engage in speaking practice at any convenient time.

The study's results also support the ideas proposed by Lu et al. (2026) according to whom AI technologies help in encouraging independent learning and engaging in language practice. Particularly, learners were satisfied with receiving instant feedback from an AI, as well as its accessibility and safe and non-intimidating environment, where they were not afraid of being judged or making mistakes. However, although there were no doubts regarding the efficacy of AI conversational tools for improving academic results, several problems were also reported by respondents. Specifically, as is evident from Table 4, students reported difficulties associated with unreliable internet connection, lack of access to technological tools, unpredictable behavior of chatbots, and a limited range of emotions of an AI tool. In this regard, Xiao et al. (2024) note that limited emotional intelligence and inability to communicate with a real human still are the most important drawbacks of AI-powered language learning. Additionally, some participants voiced fears about reducing opportunities for face-to-face communication due to the overuse of technology. This idea was shared by Alanazi et al. (2025), who pointed out that accessible technological infrastructure and adequate instructions are needed to achieve the best results from AI learning.

Conclusion

Within the context of an ongoing PhD research project, this systematic review sought to examine the extent to which Generative Artificial Intelligence (AI) technologies, when used as conversation partners, contribute to the development of speech skills of EFL learners oral communicative skills. According to the results of the research, it can be stated that the use of AI technologies as conversation partners helps to develop speaking skills, including fluency, pronunciation, grammar, conversational skills, and confidence. Those learners who trained speaking skills using generative technologies performed better in comparison with those who did not use them. In addition, it was found out that generative AI technologies help to eliminate speaking anxiety, as they create a comfortable, flexible and non-judgmental environment for studying.

Nevertheless, there have been certain challenges observed in adopting AI in education, such as insufficient emotional awareness on the part of AI, ethical issues, poor technological infrastructure, connectivity issues, and lack of teacher training. Hence, it is suggested that educational organizations ensure provision of appropriate technological facilities, reliable internet connection, and teacher training for effective utilization of AI technologies in language teaching. In addition, educational organizations need to formulate an ethical framework of AI and promote integration between AI-supported learning and personal contact among teachers and students for better communication skills of students.

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AI-Enabled E-Portfolios for Authentic Assessment and Digital Credentialing in Language Learning

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Abstract

Traditional language assessment systems are increasingly inadequate for capturing the dynamic, process-oriented nature of second language acquisition in digital and online learning environments. Despite growing interest in e-portfolios and AI-assisted feedback, few empirical studies have examined their integration within a unified, tiered-access platform that also incorporates digital credentialing. This mixed-methods study evaluates an AI e-portfolio system for language learners, combining CEFR-aligned automated feedback with digital credentials. Tracking 120 users through platform analytics, surveys, and 18 interviews, the research demonstrates how automated validation processes can enhance global academic recognition.

Learners demonstrated significantly higher engagement with AI feedback than anticipated, with 78% rating it as helpful or very helpful. Portfolio submission rates were three times higher when AI feedback was available within 24 hours of submission. Expert comparison confirmed moderate-to-high AI-human agreement on grammatical and lexical dimensions, with lower agreement on task achievement, revealing a persisting limitation in automated discourse evaluation. The study contributes an original empirical account of AI-enabled e-portfolio deployment in language education, demonstrating its promise as an equitable, scalable assessment alternative while identifying equity concerns within tiered access models. Implications are drawn for instructional designers, language educators, assessment scholars, and EdTech developers.

Keywords: AI-Enabled E-Portfolio, Automated Feedback, Digital Credentialing, Language Assessment, Open Badges

Introduction

The current landscape of global English Language Teaching (ELT) in 2026 is defined by a profound "Trust Paradox" that sits at the intersection of unprecedented digital accessibility and a widening credibility gap. On one hand, the technological revolution has democratized elite knowledge to an extent previously unimaginable, allowing "hopeful" learners from the Global South, including regions like Nepal, Malaysia and India, to access high-level curricula from institutions, such as Harvard, Oxford, Cambridge, Coursera, Udemy, Future Learn, Google and so on without the prohibitive costs of physical relocation. This democratization is powered by a robust ecosystem of AI-enabled platforms, including Google for Education, SchoolAI (app.schoolai.com), and Fobizz.com, which offer affordable, life-changing educational experiences.

Furthermore, technical mastery is no longer the only way to acquire academic certifications by traditional universities. Online skills and certificates providers like FreeCodeCamp.com, W3schools.com, Cursor AI, Replit and cutting-edge models from DeepSeek and Anthropic offer specialised coding and language tracks that allow professionals to escalate their academic endeavors with satisfying results.

Assessing second language (L2) proficiency has long been recognised as both complex and controversial. As language learners become increasingly diverse in their linguistic backgrounds, learning pathways, educational settings, and access to support, the limitations of traditional standardised testing are becoming more evident. Conventional assessments tend to provide isolated snapshots of performance rather than capturing the ongoing, reflective, and developmental nature of language learning itself (Black & Wiliam, 1998).

At the same time, rapid digital transformation is changing how language education is delivered and experienced. Online learning platforms, asynchronous instruction, and AI-supported educational tools have expanded access to language learning while also increasing the demand for more flexible and innovative assessment practices. Many learners now study outside conventional classroom environments and often lack regular access to instructors who can provide timely and personalised feedback. This mismatch between learners' needs for continuous support and institutions' ability to provide it has become a major challenge in modern language education (Warschauer & Grimes, 2008).

Electronic portfolios, commonly known as e-portfolios, have frequently been proposed as a way to address this issue. By allowing learners to collect, reflect on, and present authentic samples of their language use over time, e-portfolios offer a broader and more meaningful representation of language development than single high-stakes examinations (Barrett, 2007; Yancey, 2009). Nevertheless, traditional e-portfolio systems face significant practical limitations. They require considerable instructor involvement, are time-consuming to assess, and often remain disconnected from modern digital credentialing systems (Beckett et al., 2013; Little, 2009).

This paper presents the design, implementation, and preliminary evaluation of one such platform: the AI-Enabled Language Portfolio (AILP). The platform was piloted with adult language learners enrolled in both free and paid course tiers, reflecting the varied access conditions commonly found in online language learning environments today. The study adopted a convergent parallel mixed-methods approach, combining platform analytics, learner surveys, semi-structured interviews, and expert rubric comparisons to examine system effectiveness, learner experiences, and issues of equitable access.

Review of Related Literature

The theoretical and empirical basis of this study draws from three closely connected areas: e-portfolio pedagogy and assessment, artificial intelligence in language education, and digital credentialing. This review brings together key scholarship from these fields in order to highlight the conceptual gap that the present study seeks to address.

E-Portfolios in Language Learning: Practical Implementation

Empirical Evidence from Language Education

Research on the use of e-portfolios in language education has generally produced positive findings, although outcomes often depend on the learning context. Klenowski et al.

(2006) reported that e-portfolios in higher education encouraged learner reflection and promoted a developmental understanding of language performance. Similarly, Cheng and Warren (2010) found that portfolio assessment in EFL writing courses improved both writing quality and learners' metacognitive awareness of the writing process, particularly among lower-proficiency learners who benefited from repeated cycles of feedback and revision.

Scalability and the Instructor Bottleneck

A recurring challenge within the e-portfolio literature is balancing pedagogical quality with operational scalability. Meaningful portfolio assessment requires substantial instructor involvement, including reviewing multiple drafts, providing individualised feedback, and engaging learners in reflective dialogue. In large-scale online learning environments, where instructors may be responsible for hundreds of asynchronous learners, maintaining this level of interaction becomes extremely difficult (Dörnyei & Ushioda, 2011; Locker & Jaques, 2018).

This scalability challenge has increased interest in AI-assisted feedback systems as a way to reduce dependence on instructor availability while still supporting formative assessment processes.

Artificial Intelligence in Language Assessment

Automated Essay Scoring: Origins and Development

The use of computational approaches in language assessment dates back more than sixty years. One of the earliest systems, Project Essay Grade, was introduced by Page (1966). This system relied on surface-level textual features such as word frequency, sentence length, and syntactic complexity as indicators of writing quality. Over time, more advanced automated scoring systems were developed, including e-rater (Burstein et al., 1998), Intelligent Essay Assessor (Landauer et al., 2003), and MY Access! (Vantage Learning, 2000).

Since 2017, the field has undergone major transformation due to the emergence of transformer-based large language models (LLMs). Beginning with models such as BERT (Devlin et al., 2019) and advancing rapidly through GPT-3 (Brown et al., 2020), GPT-4, and related systems, AI technologies have become significantly more capable of understanding and generating natural language.

CEFR-Aligned Automated Assessment

Automated Writing Assessment (AWE) systems are an early and widely used form of artificial intelligence in writing instructions (Shen, 2025). An important advancement in AI-supported language assessment has been the alignment of automated feedback systems with established language proficiency frameworks, particularly the Common European Framework of Reference for Languages (CEFR). The CEFR offers a six-level proficiency scale ranging from A1 to C2 and provides detailed "can-do" descriptors that outline observable communicative abilities at each level (Council of Europe, 2001). Because the framework is widely recognised by educational institutions, testing organisations, and language programmes worldwide, it provides a strong foundation for structuring AI-generated language feedback.

Learner Perceptions of AI Feedback

Research examining learners' attitudes toward AI-generated feedback has generally reported positive responses, especially regarding speed, consistency, and the reduced

social pressure associated with automated systems. Warschauer and Grimes (2008) conducted one of the earliest systematic investigations into learner perceptions of automated writing evaluation (AWE) in second-language contexts. Their study found that learners appreciated the immediacy and specificity of automated feedback, although they still preferred human instructors for addressing higher-order writing concerns.

Limitations and Validity Concerns

Despite growing enthusiasm for AI-based language assessment, important concerns remain regarding its validity and fairness. Bridgeman et al. (2012) found that automated essay scoring systems might perform unevenly across different learner populations. In particular, lower agreement rates were observed for essays produced by non-native English speakers from diverse linguistic backgrounds compared to native speaker writing. This raises concerns about algorithmic bias, especially when systems are trained predominantly on English-first-language corpora.

Digital Credentialing in Education

The Architecture of Open Badges

The concept of open badges was formally introduced by Mozilla in 2011 through the Open Badges Infrastructure (OBI), a framework designed for issuing, displaying, and verifying digital credentials. Unlike simple visual achievement icons, open badges are portable and verifiable digital records containing embedded metadata, such as the issuing organisation, award criteria, supporting evidence, and date of issuance (Mozilla Foundation, 2011).

Gibson et al. (2015) conducted one of the earliest comprehensive studies on the use of open badges in higher education and identified four major advantages: recognising informal and non-formal learning, motivating learners through visible achievement milestones, enabling credentials to be combined into larger qualification pathways, and allowing credentials to be shared across professional and social platforms.

Micro-Credentials and the Granularisation of Language Competence

Alongside the development of open badges, micro-credentials have emerged as another important form of digital certification. Micro-credentials are focused qualifications that certify achievement within a narrowly defined skill area (Oliver, 2019). In language education, they offer opportunities to recognise competencies that are often overlooked by traditional qualifications. Examples include writing formal business emails at a B2 level, demonstrating spoken fluency in hospitality-related communication, or summarising academic texts in a second language.

Motivation, Gamification, and Digital Badges

Research into the motivational impact of digital badges has been strongly influenced by self-determination theory (Deci & Ryan, 1985; Ryan & Deci, 2000) and gamification theory (Deterding et al., 2011; Hamari et al., 2014). From the perspective of self-determination theory, badges function as external motivators that can encourage learners to internalise motivation when the rewards are perceived as meaningful and personally relevant. Under these conditions, learners may begin to see achievement activities as aligned with their own goals and identities.

Abramovich et al. (2013) conducted a significant study on badge systems in online learning environments and found that the motivational effectiveness of badges depended heavily on their design.

Credibility, Trust, and Institutional Endorsement

One of the most significant challenges facing digital credentials is the issue of credibility. Although badges and certificates often motivate learners, confidence in their external recognition remains uncertain. Selingo (2018) found that employer acceptance of digital badges and micro-credentials was still relatively limited, especially in sectors where traditional university degrees continue to hold strong signalling value. Gallagher and Palmer (2020) argued that institutional partnerships and co-endorsement play a crucial role in increasing trust in alternative credentials, highlighting the importance of collaboration between educational providers and recognised institutions.

Research Gap

The literature reviewed above highlights an important gap in current research. Although substantial scholarship exists on e-portfolio pedagogy, AI-assisted language feedback, and digital credentialing individually, very few studies have explored the integration of all three within a single platform designed specifically for language learning. To date, no published empirical study has examined such integration within a tiered-access environment that combines AI-generated feedback, portfolio assessment, and digital credentialing in one unified system.

In addition, existing research has paid limited attention to the equity implications of tiered-access AI assessment systems. As digital learning technologies become increasingly common, concerns are growing that unequal access to advanced educational tools may reproduce or intensify existing educational inequalities. Despite this concern, little practical work has investigated how different access levels within AI-enabled assessment systems may shape learner experiences and outcomes. This study aims to address both of these gaps.

Objectives

This study aims to achieve the following objectives:

- To develop and describe an integrated AI-enabled e-portfolio system that combines automated CEFR-aligned feedback, multimodal artefact submission, and competency-based digital credentialing.
- To examine learners' engagement with AI-generated feedback and explore their perceptions of its usefulness across both free and paid course tiers.
- To evaluate the validity of AI-generated feedback by comparing it with expert human assessment across four language-related dimensions.
- To investigate learners' attitudes towards digital credentials and explore how these credentials influence motivation and portfolio completion.
- To analyse issues of equity within tiered access conditions and identify design considerations for creating more inclusive AI-enabled assessment systems.

Research Questions

The study is guided by the following research questions:

- RQ1: How do language learners perceive and interact with AI-generated feedback within an integrated e-portfolio environment, and are there differences between free-tier and paid-tier learners?

- RQ2: To what extent does AI-generated language feedback correspond with expert human assessment across four CEFR-aligned dimensions: grammatical accuracy, lexical range and appropriacy, discourse coherence, and task achievement?
- RQ3: What role do digital badges and certificates play in motivating learners to engage with and complete portfolio-based assessment activities?
- RQ4: What equity-related concerns arise from the implementation of a tiered-access AI-enabled e-portfolio system, and how might these concerns be addressed through platform design and educational policy?

Methodology

This study employed a convergent parallel mixed-methods design (Creswell & Plano Clark, 2018), in which quantitative and qualitative data were collected simultaneously, analysed separately, and then integrated during the interpretation stage. This approach was selected because it allows for a more comprehensive understanding of the research problem than either quantitative or qualitative methods alone. Quantitative data from platform analytics and learner surveys provided measurable insights into patterns of engagement and learner attitudes, while qualitative interview data offered deeper contextual explanations of these patterns and learner experiences.

Study Design and Paradigm

The research was situated within a pragmatist paradigm (Tashakkori & Teddlie, 2010), which prioritises the research questions themselves when determining methodological choices. Rather than adhering strictly to one methodological tradition, pragmatism values the complementary strengths of both quantitative and qualitative approaches.

System Description: The AI-Enabled Language Portfolio (AILP)

Platform Architecture

The AILP platform was developed as a modular, cloud-based web application consisting of three interconnected functional components. The first component was a portfolio management interface that allowed learners to upload multimodal artefacts and maintain reflective learning journals. The second component was an AI-powered feedback and assessment engine designed to provide CEFR-aligned analysis of written and spoken language submissions. The third component was a digital credentialing module capable of issuing open badges and verifiable PDF certificates once learners achieved specified competency benchmarks.

The platform was built using Moodle 4.1 as a headless learning management system, combined with customised API integrations linking the portfolio interface to the AI assessment engine and credentialing infrastructure. The credentialing system followed the Open Badges v2.0 specification and incorporated blockchain-based verification to ensure credential authenticity.

Tiered Access Structure

The platform operated using a dual-tier access model intended to accommodate learners with differing financial and institutional resources. The free and paid tiers provided different levels of access to platform features, while maintaining a shared core learning environment. summarises the distribution of features across both tiers

Table 1. Feature distribution across free and paid platform tiers

Feature	Free Tier	Paid Tier
Portfolio submission & storage	Yes (unlimited)	Yes (unlimited)
AI written feedback	Yes (up to 10/month)	Yes (unlimited)
Spoken language feedback	No	Yes
Learning analytics dashboard	Basic (submission count)	Full (progress tracking, trends)
Course completion certificate	Yes	Yes
Competency micro-badges	Core badges only (3)	Full suite (12 badges)
Instructor review request	No	Yes (2 per module)
Peer feedback tools	Yes	Yes

AI Feedback Engine

The AI feedback engine analyses submitted written artefacts across four dimensions derived from CEFR writing assessment criteria (Council of Europe, 2001): (a) grammatical accuracy and range, (b) lexical resource and appropriacy, (c) discourse coherence and cohesion, and (d) task achievement and communicative effectiveness. Each dimension is scored on a 1–5 Likert scale calibrated to CEFR levels (1 = A1–A2; 3 = B1–B2; 5 = C1–C2), and specific actionable feedback is generated for each dimension within the same response.

Participants

The pilot study involved 120 adult learners enrolled in online English language courses delivered through the AILP platform during an eight-week period. Participants were recruited through purposive sampling from the existing platform user base, stratified to achieve balanced representation across proficiency levels and course tiers. Table 2 presents the participant profile.

Table 2. Participant demographic and proficiency profile by course tier.

Characteristic	Free Tier (n = 65)	Paid Tier (n = 55)	Total (n = 120)
Age range (years)	19–52 (M = 31.4)	22–48 (M = 33.1)	19–52 (M = 32.2)
Gender (% female)	54%	60%	57%
CEFR proficiency (A2–B1)	48%	36%	43%
CEFR proficiency (B2–C1)	52%	64%	57%
L1 background (languages)	14 languages	11 languages	18 languages
Prior e-portfolio experience	31%	44%	37%
Country of residence (top 3)	Malaysia, Nepal, Sudan, Syria, Sri Lanka, Saudi Arabia	Malaysia, Saudi Arabia, Bangladesh	Malaysia, Nepal, Yemen

All participants were adults (over 18 years old) with voluntary enrollment in different online courses. The study excluded learners who did not complete at least three portfolio submissions during the pilot period, as minimum engagement was required for meaningful data generation. Eighteen participants from the broader cohort were selected for semi-structured interviews using maximum variation sampling to ensure representation of diverse proficiency levels, tier memberships, and L1 backgrounds.

Participant Profile by Course Tier

Grouped bar chart showing key demographic and proficiency characteristics of the 120 participants (free: n = 65; paid: n = 55). Variables: total per tier, CEFR proficiency (A2-B1 and B2-C1), gender (female), and prior e-portfolio experience. Paid-tier learners showed higher B2-C1 proficiency (64% vs. 52%) and prior e-portfolio experience (44% vs. 31%), both relevant to interpreting tier-based outcome differences.

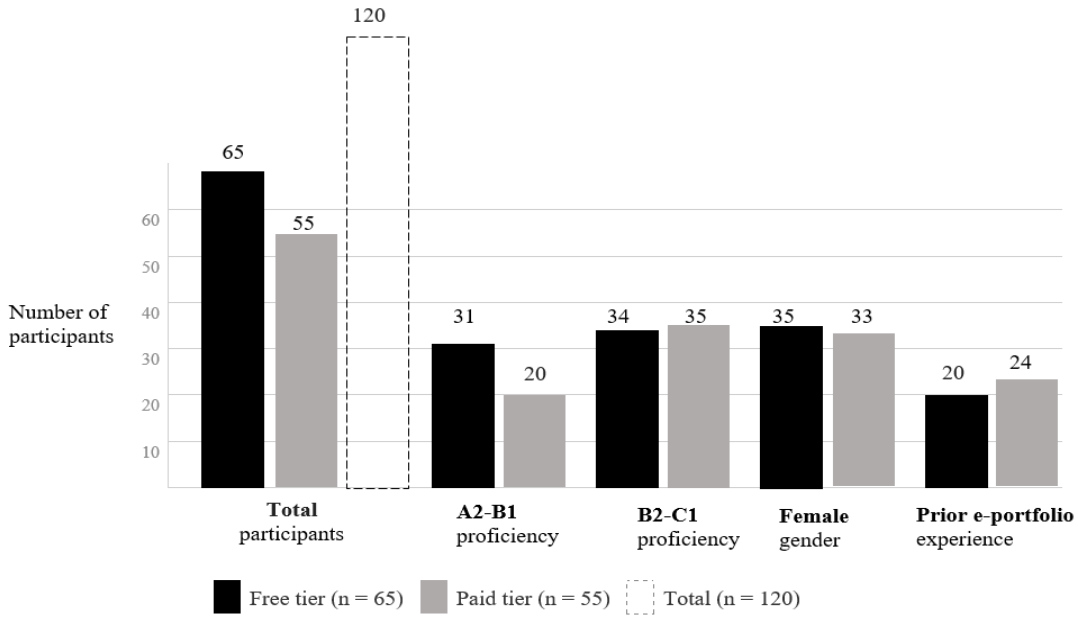

Figure 1. Participant profile by course tier

Participants recruited via purposive sampling; stratified for proficiency and tier balance

Figure 1. Participant demographic and proficiency profile by course tier (n = 120). Free tier (dark bars, n = 65); Paid tier (light bars, n = 55). Purposive sampling, stratified for proficiency and tier balance.

Note: 18 L1 backgrounds; top countries: Malaysia, Nepal, Sudan, Syria. Mean age: free M = 31.4 yrs, paid M = 33.1 yrs. Learners with fewer than 3 submissions were excluded.

AILP System Architecture: Three Functional Layers

Three interconnected layers within a Moodle 4.1 headless LMS: (1) portfolio management interface for multimodal artefact submission; (2) AI feedback engine, GPT-4 fine-tuned on CEFR-annotated samples, providing four-dimensional CEFR-calibrated scoring; (3) digital credentialing module issuing Open Badges v2.0 credentials with blockchain verification. The dual-tier access model operates horizontally across all three layers.

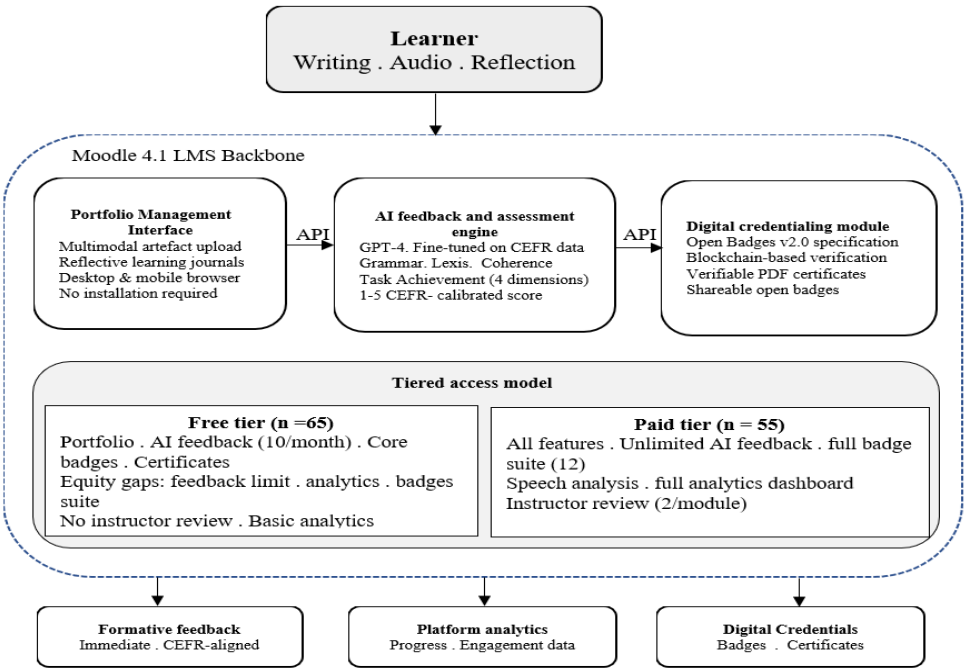

Figure 2. AILP platform architecture showing the three functional layers (portfolio management, AI feedback engine, digital credentialing module) within the Moodle 4.1 LMS backbone and the dual-tier access model.

Note: All features were accessible via desktop and mobile web browsers with no software installation required. API integrations connect the three layers; the credentialing module links to an external blockchain verification registry.

Data Collection Instruments

Platform Analytics

Anonymised platform analytics data were extracted from the LMS dashboard at the close of the pilot period. Metrics captured included: total submissions per learner; AI feedback interaction rate (submissions followed by revision within 72 hours); feedback ratings (learner-initiated helpfulness ratings on a 5-point Likert scale); time-on-task data; badge and certificate award rates; and cross-tier comparative engagement data. These metrics operationalised the quantitative aspects of RQ1, RQ3, and RQ4.

Learner Surveys

Two structured surveys were administered: a mid-pilot survey (Week 4) focusing on AI feedback perceptions and platform usability, and a post-pilot survey (Week 8) focusing on credential attitudes, overall system evaluation, and equity perceptions. Both surveys employed a combination of five-point Likert scale items, semantic differential scales, and open-ended response fields. The surveys were pilot-tested with five learners not included in the main study and revised for clarity before administration. Survey reliability was assessed using Cronbach's alpha, yielding acceptable internal consistency coefficients (mid-pilot: $\alpha = .82$; post-pilot: $\alpha = .79$).

Semi-Structured Interviews

Eighteen participants completed individual semi-structured interviews conducted via video conferencing platforms, lasting between 30 and 40 minutes. Interview protocols were developed deductively from the research questions and inductively from

preliminary survey themes, covering five topic areas: (1) prior experience with e-portfolios and AI tools; (2) perceptions of AI feedback quality and usefulness; (3) the role of digital credentials in motivation and identity; (4) experiences of the tier model and perceived equity; and (5) recommendations for system improvement. Interviews were audio-recorded, transcribed verbatim, and member-checked for accuracy.

Expert Rubric Comparison

To assess the construct validity of AI-generated feedback (RQ2), two experienced language assessment specialists, both holding postgraduate qualifications in applied linguistics with a minimum of ten years' assessment experience, independently evaluated a random stratified sample of 30 learner submissions (15 from each tier; 15 spanning A2–B1, 15 spanning B2–C1) using the same four-dimensional rubric employed by the AI system. AI scores and feedback on the same submissions were provided to the experts without identifying information, and inter-rater agreement between expert assessments and AI outputs was calculated using Cohen's kappa (κ) and intraclass correlation coefficients (ICC).

Analysis

Quantitative Analysis

Quantitative data from platform analytics and surveys were analysed using IBM SPSS Statistics 29. Descriptive statistics (means, standard deviations, frequencies, and percentages) were used to characterise engagement patterns and survey response distributions. Independent samples t-tests and Mann-Whitney U tests were used to compare quantitative outcomes between free and paid tier participants, with statistical significance set at $p < .05$. Effect sizes were reported using Cohen's d for parametric comparisons and r for non-parametric comparisons.

Qualitative Analysis

Interview transcripts and open-ended survey responses were analysed using reflexive thematic analysis following the six-phase framework of Braun and Clarke (2006, 2019). Familiarisation with data was followed by systematic coding in NVivo 14, enabling iterative refinement of an initial coding frame into thematic clusters. Two researchers independently coded a 20% subset of transcripts to establish coding reliability ($\kappa = .76$), and divergences were resolved through discussion. Analysis was conducted with explicit reflexive awareness of the researcher's dual role as system developer and study investigator.

Integration

Quantitative and qualitative findings were integrated at the interpretation stage using a joint display matrix (Fetters et al., 2013), in which quantitative patterns were placed alongside corresponding qualitative themes to identify points of convergence, complementarity, and divergence. Divergent findings, instances where quantitative data pointed in a different direction from qualitative accounts, were treated as analytically productive and subjected to additional interpretive scrutiny.

Ethical Considerations

All participants provided informed written consent prior to data collection. Anonymity was ensured through the replacement of all identifying information with participant codes in transcripts and data files. Learners were informed that non-participation would have

no effect on their course access or assessment outcomes. Data were stored on encrypted institutional servers accessible only to the research team, and will be retained for five years following publication in line with institutional data management policy.

Findings and Discussion

This section presents the integrated findings from the four data sources, organised by research question. Unless otherwise stated, percentages refer to survey respondents (n = 112 usable mid-pilot surveys; n = 108 usable post-pilot surveys) and analytics data refer to the full cohort of qualifying participants (n = 120).

RQ1: Learner Engagement with and Perceptions of AI Feedback Engagement Patterns

Overall, learners submitted a mean of 7.4 portfolio artefacts during the eight-week pilot period (SD = 2.9), compared to a pre-pilot institutional average of 2.3 submissions per learner per equivalent period—a statistically significant increase ($t(119) = 14.2$, $p < 0.001$, $d = 1.30$). Paid-tier learners submitted significantly more artefacts ($M = 9.1$, $SD = 2.4$) than free-tier learners ($M = 5.8$, $SD = 2.8$; $t(118) = 7.1$, $p < 0.001$, $d = 1.29$). However, among free-tier learners who reached the platform-imposed monthly feedback limit (n = 27), subsequent submission rates dropped markedly—an average of 2.1 submissions in the week following limit-exhaustion, compared to 4.8 in the preceding week—suggesting that feedback availability was a significant driver of submission behaviour.

Portfolio completion rates, defined as submitting at least one artefact per active week across the eight-week pilot, were 74% for paid-tier learners and 58% for free-tier learners, a statistically significant difference ($\chi^2(1) = 4.02$, $p = .045$). However, free-tier learners who had not exhausted their feedback allowance showed completion rates (71%) statistically comparable to paid-tier learners ($p = .67$), reinforcing the interpretation that feedback volume, rather than tier membership per se, was the primary engagement driver.

Perceived Feedback Quality

On the post-pilot survey, 78% of respondents rated AI feedback as “helpful” or “very helpful” overall, with 82% rating it positively for grammar and vocabulary and 71% for discourse organisation. Ratings were significantly lower for task achievement feedback (61%), consistent with the expert comparison findings reported in Section 4.2.

Interview data provided qualitative texture to these ratings. The most consistently appreciated dimension of AI feedback was immediacy: sixteen of eighteen interviewees mentioned receiving feedback quickly as a significant factor in their continued engagement. One participant (P7, B2, free tier) expressed this as follows:

> *"When I submit something at 11 o'clock at night, I don't want to wait three weeks for a teacher to read it. I get the feedback immediately. I read it, I understand it, I fix it. That is how I want to learn."*

Learners at lower proficiency levels (A2–B1) expressed more mixed evaluations. Several (n = 9) found the vocabulary used in AI feedback itself to be challenging, reporting difficulty understanding the diagnostic commentary even when they broadly understood the corrections suggested. This finding points to a design gap in proficiency-adaptive feedback language—a limitation discussed further in Section 5.

Tier Comparison

The cross-tier comparison yielded a nuanced pattern. While paid-tier learners reported higher overall feedback satisfaction (M = 4.12 vs. M = 3.78 on a 5-point scale; t(110) = 2.89, p = .005, d = 0.55), qualitative data suggested that this difference was largely attributable to the richer feature set of the paid tier—particularly the spoken language feedback and analytics dashboard—rather than the quality of written feedback per se, which learners across both tiers rated comparably (M = 3.91 vs. M = 3.83; p = .41). This supports the platform's design intention that written feedback quality should not vary by tier.

RQ2: Validity of AI Feedback — Expert Comparison

The expert rubric comparison yielded differentiated results across the four assessment dimensions, as summarised in Table 3.

Table 3. Inter-rater agreement between AI-generated and expert human assessment scores across four CEFR-aligned dimensions.

Assessment Dimension	Cohen's κ	ICC (95% CI)	Agreement Level
Grammatical accuracy & range	.72	.81 (.67–.90)	Substantial
Lexical resource & appropriacy	.68	.77 (.62–.87)	Substantial
Discourse coherence & cohesion	.54	.63 (.45–.77)	Moderate
Task achievement & communicative effectiveness	.38	.47 (.26–.63)	Fair
Overall composite score	.61	.71 (.55–.82)	Substantial

Substantial agreement on grammatical accuracy (κ = .72) and lexical resource (κ = .68) confirms that the AI feedback engine reliably operationalises these lower-order constructs in ways that align with expert judgement. Moderate agreement on discourse coherence (κ = .54) suggests that the engine captures some but not all of the features that expert assessors attend to in evaluating text organisation and cohesive flow—a finding consistent with Llosa and Malone (2019) and attributable in part to the inherently holistic and interpretive nature of coherence assessment. The fair agreement on task achievement (κ = .38) represents the most significant finding from the expert comparison and warrants extended discussion.

RQ3: Motivational Role of Digital Credentials

Quantitative Evidence of Credential Motivation

By the close of the pilot period, 89 of 120 participants (74%) had been awarded at least one digital badge, and 61 (51%) had been awarded a course segment completion certificate. Among those who had received a badge, 91% reported on the post-pilot survey that they intended to share it publicly—most commonly via LinkedIn (68%), followed by personal or academic portfolios (43%) and WhatsApp/social media (31%).

Survey items directly probing motivational effects showed strong positive responses: 84% of respondents agreed or strongly agreed that "earning a badge or certificate

motivated me to complete the required portfolio tasks," and 79% agreed that "digital credentials made my progress feel more real and meaningful." The motivational effect was significantly stronger for paid-tier learners ($M = 4.31$ vs. $M = 3.94$; $t(106) = 2.54$, $p = .013$, $d = 0.49$), potentially reflecting the broader range of badges available to paid learners and the associated richer sense of a credential pathway.

Qualitative Accounts of Credential Value

Interview data revealed three distinct dimensions of credential value. The first, and most frequently articulated, was identity recognition, the sense that a badge or certificate made visible a competence that had previously existed only in the learner's private experience.

User Type 1:

> *"I have been speaking English for years and everyone in my workplace knows I speak well. But I never had anything to show on paper. Now I have a badge. It says B2 Academic Writing. I put it on LinkedIn and three people commented. That matters."*

> Type 2: *"I have been learning English in a foreign land, but I have never been able to assess my actual English language finesse with AI, which is also considered to be a native English examiner. After assessing my English language ability using 'sharedpearls.com', I am confident that what I am perfect in and what I need to improve in order to attain my academic goals."*

The second dimension was goal crystallisation—the sense that the credential system gave learners a concrete and proximate target to work towards, transforming a diffuse aspiration (improving English) into a structured achievement pathway:

> *"Without the badge, I just knew I had to submit. With the badge, I knew exactly what I had to do and what I would get. It was like a map. I knew where I was going."*

The third dimension—credential credibility—was more ambivalent. While most learners were motivated by badges, several expressed concern about their external recognition:

> *"I like it. But I don't know if my employer will think it is real. It's from a computer. They don't know this company. Cambridge—they know. IELTS—they know. This? I'm not sure."*

This credibility concern was expressed by 12 of 18 interviewees in some form, making it the most prevalent concern in the qualitative dataset and aligning with wider literature on employer trust in non-traditional credentials (Selingo, 2018; Gallagher & Palmer, 2020).

AI Feedback as a Scalable Formative Tool

The engagement data from this study provide compelling evidence that AI-enabled feedback can function as a genuine driver of formative learning activity in language education contexts. This finding extends Warschauer and Grimes's (2008) earlier work on automated writing evaluation by demonstrating engagement effects in a more naturalistic, non-experimental, longitudinal online learning context.

The expert comparison results confirm a differentiated picture of AI validity that has significant implications for how AI feedback should be positioned pedagogically. For grammatical and lexical feedback, the AI engine demonstrates significant agreement with expert assessment and can therefore be considered a reliable source of formative feedback that learners can rely on.

Digital Credentials as Motivational Architecture

The credential motivation findings extend the empirical literature on badge-based motivation in several meaningful ways. The 84% agreement that credentials motivated task completion is among the highest reported in the literature for a non-gaming educational context (cf. Hamari et al., 2014; Abramovich et al., 2013), and the qualitative accounts of identity recognition and goal crystallisation suggest that the motivational mechanism operates at a deeper level than simple extrinsic reward—evidence that is consistent with the identified and integrated regulation modes of self-determination theory (Deci & Ryan, 1985; Ryan & Deci, 2000).

Equity and the Ethics of Tiered Assessment

The equity findings of this study represent perhaps its most significant contribution to the literature, and the most pressing implication for platform design and policy. The feedback cliff effect, the analytics information inequalities, and the credential access gap together constitute a pattern of structural disadvantage embedded in the tiered access model—one that systematically disadvantages precisely those learners who are most likely to need the platform's formative and credentialing affordances essentially.

Implications for Theory, Practice, and Policy

Theoretically, this study contributes to the ongoing development of a sociotechnical theory of AI-mediated formative assessment. The findings demonstrate that AI feedback is not simply a technical substitute for human feedback but a distinct pedagogical medium with its own affordances (immediacy, consistency, scalability, non-judgmental tone), limitations (task achievement validity, proficiency-adaptive language), and equity implications (differential access effects).

For practitioners, the study provides an empirically grounded model for integrating AI feedback within portfolio-based language assessment, demonstrating that this integration is both technically feasible and pedagogically effective at scale.

For policy, the equity findings constitute an argument for regulatory attention to the access conditions of AI-enabled educational tools. As AI assessment platforms increase in language education contexts globally, the risk of replicating and amplifying existing educational inequalities through tiered access models is real and significant.

Table 1. Independent Sample Size Effects.

		Standardizer[a]	Point Estimate	95% Confidence Interval	
				Lower	Upper
AI-based tools improve the overall quality of language teaching/learning.	Cohen's d	.996	0.019	-0.516	0.555
	Hedges' correction	1.010	0.019	-0.509	0.547
	Glass's delta	.793	0.024	-0.511	0.560

AI can help provide personalized learning experiences for students.	Cohen's d	1.042	-0.399	-0.938	0.143
	Hedges' correction	1.056	-0.394	-0.925	0.141
	Glass's delta	1.167	-0.356	-0.899	0.195

a. The denominator used in estimating the effect sizes.
Cohen's d uses the pooled standard deviation.
Hedges' correction uses the pooled standard deviation, plus a correction factor.
Glass's delta uses the sample standard deviation of the control group.

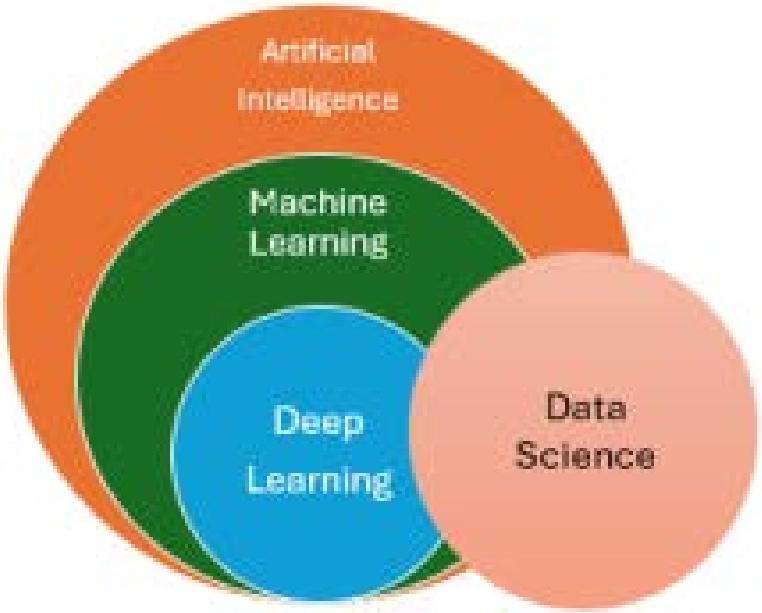

Figure 1: Subsets of AI

Conclusion

This study has reported on the design, implementation, and mixed-methods evaluation of the AI-Enabled Language Portfolio (AILP), an integrated platform combining AI-powered formative feedback, portfolio-based authentic assessment, and digital credentialing for adult language learners. The pilot study generated evidence across four research questions, producing findings that are both encouraging and cautionary in their implications for the field.

On the encouraging side: learner engagement with AI feedback substantially exceeded historical baselines; feedback immediacy emerged as a powerful driver of formative revision cycles; expert comparison confirmed substantial AI validity for grammatical and lexical assessment; and digital credentials demonstrated strong motivational effects consistent with self-determination theory's account of identified regulation. These findings collectively position AI-enabled e-portfolio systems as a promising and empirically grounded alternative to conventional language assessment in online and large-scale educational contexts.

The study's principal limitations include its single-platform, single-institution, eight-week pilot design, which limits generalisation of findings to other technological and institutional contexts. Future research should address these limitations through multi-site, longitudinal investigations; comparative studies of AI feedback validity across diverse L1 populations and proficiency levels; and empirical evaluation of the institutional endorsement strategies most effective in establishing digital credential credibility. Researchers should also attend to the long-term learning outcomes of AI-enabled portfolio assessment: a question this pilot study, by design, could not answer.

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Analysis of AI Governance in Education Transformation in Indonesia: Opportunities and Challenges

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Abstract

Artificial Intelligence constitutes a fundamental aspect of modern digital society, necessitating not fear or avoidance, but comprehensive understanding and appropriate governance. However, the development of Artificial Intelligence can be understood as a double-edged phenomenon: while it offers significant benefits, its application also entails substantial and inherent risks. This study examines the implementation of AI policies in Indonesian education and the factors influencing them, based on Edward III's policy implementation theory. This study adopts a qualitative research approach based on document analysis, followed by a systematic data analysis procedure encompassing data reduction, data display, verification, and the formulation of conclusions. The study finds that although policies supporting AI implementation have been established, policy communication remains unclear among institutions, and human resources and infrastructure are insufficient. Effective implementation of AI in learning necessitates the alignment of stakeholders' attitudes with shared objectives, as well as the development of a streamlined bureaucratic structure that supports efficient policy execution. Therefore, the recommendation that can be proposed in this context, where the government serves as the primary actor in the governance of AI implementation, is the need for stronger integration, particularly among institutions, enhancement of resource capacity, and the sustained implementation of digital literacy initiatives.

Keywords: AI Governance, Digital Literacy, Education Reform, Public Policy

Introduction

Sustainable The development of digital technology nowadays has brought about profound changes in various aspects of human life, including education, psychology, bureaucracy, and even science. One of the greatest leaps in digital transformation is the emergence and adoption of Artificial Intelligence (AI). AI is a system designed to mimic human abilities such as recognizing patterns, learning from experience, and making decisions, as defined by Stuart Russell & Peter Norvig in their book, “The job of AI is to design an agent program that implements the agent function, Agent program the mapping from percepts to actions” (Russel & Norvig, 2022). Indonesia, as a large nation with a rich population and diverse cultural life, can achieve Golden Indonesia 2045 by implementing AI in various sectors. This is because technology was created to help make human work easier. AI enables more adaptive, personalized, and data-driven learning systems, thereby significantly improving the quality of education.

Review of Related Literature

The development of AI is likened to two sides of a coin: on the one hand, AI can increase the effectiveness and productivity of teaching and learning through adaptive systems that tailor materials to individual needs. AI technology enables large-scale personalized learning, a feat difficult to achieve through conventional methods. Furthermore, AI also expands access to learning resources, enabling students from diverse backgrounds to receive a quality education (Pomsta, Holmes, & Nemorin, 2023). As a step in responding to the development of AI in Indonesian education, the Government ratified Ministerial Regulation Number 13 of 2025 concerning Amendments to the Regulation of the Minister of Education, Culture, Research, and Technology Number 12 of 2024 concerning the Curriculum in Early Childhood Education, Elementary Education, and Secondary Education so that digital literacy in coding technology and AI begins early through students' basic education. This regulation stipulates a learning approach strengthened by encouraging in-depth learning that focuses on a comprehensive understanding of concepts, the development of critical thinking skills, and reflection in the learning process. The establishment of this regulation is a strategic step to ensure that national education policies remain aligned with the dynamics of the times and the needs of Indonesian students in the future, in producing graduates who are superior and relevant to the demands of the times (Minister of Education, 2025).

However, the various benefits of AI are also accompanied by concerns about its negative impacts. Uncontrolled use of AI can shift students' cognitive processes from deep thinking to simply receiving instant results. This has the potential to diminish critical thinking skills, creativity, and independent learning. Furthermore, the use of AI can also raise ethical issues, such as plagiarism, algorithmic bias, and misuse of personal data (Sharples, 2023). In response to this, the government through Government Regulation Number 17 of 2025 concerning the Governance of Electronic Systems for Child Protection or known as PP TUNAS by the Ministry of Communication and Digital, aims to prevent exposure to harmful content and data exploitation, against the backdrop of increasing internet use by children in Indonesia. In addition, PP TUNAS is a strategic response from the government to systematically address this issue by strengthening government collaboration with all digital stakeholders. Its derivative regulations are formed, namely Ministerial Regulation Number 9 of 2026, which limits the use of social media for children under the age of 16.

Objectives

More specifically, the Joint Decree of 7 (seven) Ministers concerning Guidelines for the Utilization of Artificial Intelligence in Educational Units was ratified on March 12, 2026. This Joint Decree was signed by the Ministry of Primary and Secondary Education, the Ministry of Higher Education, Science, and Technology, the Ministry of Communication and Digital, the Ministry of Religious Affairs, the Ministry of Home Affairs, the Ministry of Women's Empowerment and Child Protection, and the National Population and Family Planning Agency. This Joint Decree regulates the use of AI to support learning, but does not replace students' thinking skills and does not pose risks such as dependency, negative content, etc. More broadly, the Indonesian government is not yet prepared in terms of human resources or infrastructure to support the implementation of AI in education in Indonesia. Based on Edward III's theory, communication, resources, disposition, and bureaucratic structure are interrelated and influence policy implementation. Therefore, this study aims to answer the question of how AI policy is implemented in Indonesian education and the factors that influence it.

Methodology

This research uses a post-positivist paradigm. This paradigm is considered because it can describe and provide a specific, in-depth understanding of the context for addressing the implementation of AI policy, especially the education aspects in Indonesia. The post-positivist approach uses a theoretical framework as a reference and particular measurement to determine the cause and effect of an event (Creswell, 2014). In this research, the theory used is Policy Implementation by Edward III (1969). The data collection technique in this study was qualitative, using secondary data from literature reviews of various previous documents, such as related regulations, reports, and previous research published in national and international journals relevant to this research. Qualitative data collection enables researchers to understand the implementation processes of AI in Indonesian education rather than simply relying on numbers or statistics. The data analysis technique uses an interactive data model to reduce and categories the data. Irrelevant data are removed, then data are presented in the form of writing, images, tables, and graphs, after which data verification is carried out for appropriate decision- making (Miles, 2014).

Artificial intelligence, or AI, is a system designed to mimic human abilities such as pattern recognition, learning from experience, and decision-making. This technology is not alive or thinking like humans, but it is capable of processing large amounts of data to complete specific tasks, thereby helping to improve work efficiency and learning (Hermanto et al, 2024). According to the 2024 Job Trends Index released by Microsoft and LinkedIn, 92% of the workforce in Indonesia has used generative AI in various professional tasks, while 93% expressed interest in developing AI skills to increase their productivity. AI is a reality of today's digital life, not to be feared, avoided, or opposed, but to be understood and managed. By understanding and learning about it, we can develop intelligent and critical users, not just passive consumers of technology (ICT Watch, 2025).

Analysis

All forms of technological innovation must comply with human rights. AI that is discriminatory, exploitative, or that restricts social space is unacceptable. Therefore, every country needs a legal and ethical framework that protects all digital citizens. Neighbouring Singapore is a good example of this. The Singaporean government adopts a controlled integration approach, where AI is not strictly restricted, but its use is regulated through strengthening digital literacy and technological ethics. Students are encouraged to actively use AI, but with a thorough understanding of the risks and responsibilities of its use (Lee, Koh, & Looi, 2023). On the other hand, Finland places digital literacy as a key foundation through its AI for Citizens program, demonstrating that the primary focus is not on restricting technology but rather on increasing public understanding of AI. This approach has proven effective in creating an adaptive and responsible education ecosystem (Mertala, Fagerlund, & Calderon, 2022). Meanwhile, China has adopted a strategy of strict state control. In this case, although AI is widely integrated into the education system, its use is monitored through strong regulations and sophisticated supporting infrastructure (Yang & Peters, 2026).

Looking back at Indonesian history, the government has issued various policies such as the 2020 National AI Strategy as a national strategic direction, Law No. 27 of 2022 concerning Personal Data Protection, the 2023 AI Ethics Guidelines of the Ministry of

Communication and Information Technology, and the 2025–2030 National AI Roadmap Plan. More specifically, in the education sector, the Government ratified a learning curriculum policy in 2025 that encourages AI integration as part of efforts to increase the global competitiveness of human resources in Indonesia. However, the Government understands that AI also has negative impacts where uncontrolled use of AI can damage the learning process itself, so the government subsequently issued the PP TUNAS policy and the Joint Decree of 7 Ministers in 2026 that limit the use of AI in the learning process. This policy emphasises the importance of supervision, age-based restrictions, and a prohibition on the use of AI as a tool to complete learning tasks instantly. These two policies appear contradictory, with one encouraging and the other restricting. However, this can be understood as a balancing act between innovation and protection. Strengthening the use of AI through the teaching and learning curriculum represents a push to innovate and adapt to digital transformation, while the PP TUNAS and the Joint Decree of the Seven Ministers demonstrate the responsibility to protect students from the negative impacts of technology. Therefore, digital literacy is the right solution for understanding AI to prevent unintended consequences.

Findings and Discussion

Digital literacy encompasses not only technical skills but also an ethical, critical, and responsible understanding of technology use. In the context of AI, digital literacy is key to mitigating risks without stifling innovation. AI literacy extends beyond simply knowing the technology; it encompasses understanding, critical judgment, and the ability to make informed decisions when using AI. This is part of the digital literacy that every member of society, especially teachers in education, must possess, who will educate the nation's children. In today's era, children are active users of digital technology, including AI. However, they are also the most vulnerable group to manipulation, privacy violations, and exposure to inappropriate content. Digital education about AI has been proven to have a positive impact by improving overall digital literacy, so that students are not just passive users of technology but can ethically and productively utilise it in their lives and are able to adapt to the ever-evolving digital world. Most teachers agree on the implementation of AI in the elementary school curriculum because they recognize the potential of AI and coding to improve critical thinking, creativity, and problem-solving skills in students (Putri, et al., 2025).

Further analysis of AI policy in Indonesian education was conducted using the theoretical framework of policy implementation from George C. Edward III, where 4 (four) variables determine the success of a policy implementation, namely communication, resources, disposition and bureaucratic structure (Edward III, 1980). In terms of communication, AI policy and discourse in Indonesian education, especially about AI, are developing a lot at the level of ministries/institutions, academia, and public discourse, but the government is still not integrated. This is evident from each ministry/institution issuing its own policy, and there is no single national policy that comprehensively regulates the stages of AI development that must be passed, for example, with the existence of AI curriculum policies and AI restriction regulations that create unclear information on whether AI education is implemented for students or not. The communication aspect is still not optimal, so AI adoption tends to be slow and uneven. Second, the resource aspect is crucial for the success of the policy, but in the Indonesian context, it is a major weakness. Although supporting resources are available, they are not yet fully distributed. Implementing AI requires adequate digital infrastructure, devices, connectivity, and, most importantly, human competency. However, the reality on the ground shows significant

budget inefficiencies and gaps in digital infrastructure, both between regions and educational institutions. Many schools lack stable internet access or adequate devices. Furthermore, limited human resources are also a challenge, with teachers lacking sufficient AI literacy and limited expertise in this field. Furthermore, with restrictions on AI in education, even schools with adequate resources are not always able to freely implement AI due to regulations regarding age, duration, and type of use.

Third, disposition is important because the attitudes of policy implementers influence the policy itself. The attitudes of those implementing AI policies in education are divided into pros and cons. On the one hand, AI is accepted because it facilitates teaching and learning processes, such as material development and evaluation, and primarily improves digital literacy. However, on the other hand, there are also opponents due to concerns about declining learning quality, the loss of the teacher's role, ethical issues such as plagiarism, and other potential risks. This is also evidenced by the AI curriculum policy that encourages, and the Joint Decree of 7 ministers that limits the use of AI. Finally, the bureaucratic structure surrounding AI implementation in Indonesia needs improvement. The complex relationship between the central and regional governments within the Indonesian education system, coupled with the numerous authorised institutions, has resulted in a complex bureaucracy. Regulations related to AI in education are still developing and have not been fully implemented, and there is a lack of clear and aligned standard operating procedures (SOPs), such as the Joint Decree of the Seven Ministers, which emphasises restrictions on education, the education sector, and the digital sector, while focusing on risk mitigation. From Edward III's perspective, this bureaucratic structure will result in inconsistent implementation and be difficult to control. Based on Edward III's theory, the implementation of AI in Indonesian education is actually in an unstable transitional phase. While AI already exists and is regulated in policy, implementation remains hampered by a lack of synchronisation between communication, resources, disposition, and bureaucratic structure. This suggests that the primary problem lies not with the technology itself, but rather with the capacity of the government system that governs national governance, including education.

Conclusion

The development of AI is like a double-edged sword, bringing both benefits and risks. Therefore, it must be supported by adequate digital literacy in the community. Focusing on developing digital literacy in AI is crucial, as the public not only understands the technology technically but also critically understands its ethical, social, and legal aspects, as well as its ability to adapt to the technology. However, in this case, the government is the primary actor in AI implementation governance. Integration, particularly between institutions, is necessary to ensure alignment and consistency. Furthermore, resources must be strengthened, including qualified and competent human resources and adequate and equitable digital infrastructure. Finally, digital literacy must continue to be implemented with the aim of empowering the public to face global challenges.

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AI-Powered Virtual Laboratories: Enhancing Chemistry Education through Intelligent Stimulation Frameworks

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Abstract

The recent advances in the realm of Artificial Intelligence (AI) have made it possible to create intelligent virtual laboratory environments, which could overcome some of the main drawbacks of traditional chemistry teaching methods, such as limited laboratory access, potential hazards associated with practical experimentation, and prohibitive costs of equipment and materials. This paper reports on the development and evaluation of a new model of intelligent virtual laboratories powered by advanced AI algorithms. This research describes how AI tools can be utilized to improve learners' conceptual and experimental competencies in the domain of chemistry. Specifically, this work presents a design of a hybrid virtual laboratory environment featuring adaptive learning models based on reinforcement learning and learner analytics, physics-informed stimulations driven by computational chemistry algorithms, and natural language processing engines for interactive tutoring and automatic response evaluation. As part of this research, a quasi-experiment was designed and implemented to compare the efficacy of AI-driven virtual lab experience and traditional laboratory practices in enhancing students' chemistry knowledge. Participants were undergraduate students taking a required chemistry course, and they completed pre-test and post-test questionnaires and several laboratory tasks. Despite these advantages, challenges related to model interpretability, simulation fidelity, and infrastructure scalability are identified. The study underscores the potential of AI-powered virtual laboratories as scalable, data-centric educational tools capable of augmenting or partially substituting physical laboratory experiences. Future work focuses on integrating multimodal interfaces, such as augmented reality (AR), and improving model generalization across diverse chemistry curricula.

Keywords: Artificial Intelligence, Intelligent Tutoring Systems, Reinforcement Learning, Simulation-Based Education, Virtual Laboratories

Introduction

Sustainable Experimental work is the heart of chemistry education. It helps students develop hands-on skills, connect theory to practice, and learn to think like scientists. Yet physical laboratory instruction continues to face practical challenges: high operational costs, safety risks when handling hazardous chemicals, limited equipment, and large student-to-instructor ratios that leave little room for individual feedback. These issues are especially acute in large-enrolment courses and in institutions where infrastructure gaps directly affect learning.

Virtual laboratories have emerged as a practical supplement. They use computational models to simulate chemical processes, giving students access to experiments that might otherwise be impossible. However, early versions were often just digital cookbooks step-by-step visualizations with no way to adapt to a student's mistakes or probe their understanding.

Advances in AI, particularly in machine learning, computer vision, and intelligent tutoring systems, now make a different approach possible. We can build AI-powered virtual laboratories that pair accurate stimulations with pedagogical agents. These agents assess performance in real time, spot misconceptions, and guide students with hints tailored to their needs.

In this paper, we propose an intelligent stimulation framework. The word "stimulation" is deliberate. The AI does not just simulate a reaction; it actively stimulates cognitive engagement. It might introduce an unexpected result and ask students to explain it, or suggest a "what-if" change to the procedure. The system uses reinforcement learning and natural language dialogue to personalize the path for each learner, drawing on constructivist and inquiry-based learning theories.

Despite several pilot studies, the field lacks a standardized way to build this kind of AI-driven stimulation into virtual labs. There is also limited empirical evidence on how it affects real conceptual understanding and lab competence. This study addresses that gap. We present the system architecture, the AI models used for learner modelling and feedback, and results from deploying the lab in undergraduate chemistry modules.

Review of Related Literature

The integration of artificial intelligence into virtual laboratories has created new opportunities for enhancing chemistry education through intelligent simulation frameworks. Chemistry is an experimental subject that requires students to understand both theoretical concepts and practical laboratory procedures. However, traditional physical laboratories often face challenges such as limited access, safety concerns, high costs, shortage of equipment, and time restrictions. In this context, virtual laboratories provide a flexible and interactive learning environment where students can perform experiments, observe reactions, and repeat procedures without the risks and limitations of physical laboratory settings.

Pyatt and Sims (2012) examined virtual and physical experimentation in inquiry-based science laboratories and found that virtual laboratories can positively influence students' attitudes, performance, and access to science learning. Their findings suggest that virtual experimentation can support inquiry-based learning by allowing students to explore scientific concepts in a more accessible manner. Similarly, Tatli and Ayas (2013) demonstrated that virtual chemistry laboratories could improve students' academic achievement by helping them visualize abstract chemical processes and practice laboratory activities repeatedly. These studies show that virtual laboratories are not only supplementary tools but also effective platforms for improving chemistry-learning outcomes.

Potkonjak et al. (2016) further emphasized the importance of virtual laboratories in science, technology, and engineering education, highlighting their role in improving accessibility, interactivity, and learner engagement. In chemistry education, these features

are particularly valuable because many chemical processes occur at the microscopic level and are difficult for students to observe directly. Virtual simulations can help bridge this gap by representing chemical reactions, molecular interactions, and experimental procedures in a visually meaningful way.

The use of artificial intelligence can further strengthen virtual laboratory learning. VanLehn (2011) showed that intelligent tutoring systems could provide effective learning support similar to human tutoring. Chen (2022) also highlighted that AI-powered adaptive learning systems can personalize instruction, provide real-time feedback, and adjust learning tasks according to student performance. Therefore, AI-powered virtual laboratories can guide students, identify misconceptions, and support individualized learning pathways.

Wang and Hannafin (2005) emphasized the importance of design-based research in developing technology-enhanced learning environments, while Cooper and Stowe (2018) argued for evidence-based and theory-informed chemistry education. Overall, the literature indicates that AI-powered virtual laboratories can enhance chemistry education by improving access, engagement, conceptual understanding, and personalized learning through intelligent simulation frameworks.

Objectives

The main objective of this study is to propose an AI-powered virtual laboratory framework for enhancing chemistry education through intelligent stimulation-based learning. The study aims to design a virtual laboratory environment that supports students in understanding chemical concepts through interactive, safe, and accessible experimentation. It seeks to integrate artificial intelligence tools such as learner modelling, adaptive feedback, natural language dialogue, and reinforcement learning into virtual chemistry laboratories. Another objective is to examine how AI-based pedagogical agents can identify student misconceptions and provide personalized guidance during experimental tasks. The study also aims to explore how intelligent stimulation can promote inquiry-based learning by encouraging students to ask questions, test assumptions, and explain unexpected experimental outcomes. It further seeks to bridge the gap between theoretical chemistry knowledge and practical laboratory competence through adaptive simulation activities. The research intends to evaluate the effectiveness of the proposed framework in improving students' conceptual understanding, engagement, and laboratory decision-making skills. Finally, the study aims to contribute to the development of a standardized model for designing AI-driven virtual laboratories in undergraduate chemistry education.

Methodology

System Architecture: Intelligent Stimulation Framework

The virtual laboratory was built as a three-tier system:

Simulation Engine: A physics-based backend using Open Chem Lab and PhET modules to render chemical reactions, thermodynamics, and kinetics. Molecular dynamics visualizations show processes at the atomic level.

AI Tutoring Layer: A fine-tuned large language model combined with a reinforcement-learning agent. Three key functions:

Learner Modeling: Tracks student proficiency using Bayesian Knowledge Tracing.

Stimulation Module: Injects adaptive challenges, "what-if" scenarios, and controlled anomalies to provoke hypothesis testing.
Feedback Generator: Provides real-time, NLP-based hints, diagnoses errors, and uses Socratic questioning.
User Interface: A WebGL/Unity frontend with drag-and-drop apparatus, voice interaction, and a dashboard that logs student actions.

Study Design
We used a quasi-experimental pre-test/post-test control group design evaluate the intelligent stimulation framework over 6 weeks.

Table 1: Study Design and Participant Allocation

Group N	**Intervention**	**Duration**
Experimental	65	AI-powered virtual lab + 1 physical lab session 6 weeks
Control	62	Traditional physical lab only 6 weeks

Participants: 127 second-year B.Sc. Chemistry students from Fatima College, Madurai. Random assignment by lab section.

Data Collection Instruments
Conceptual Understanding: A 25-item test adapted from the ACS General Chemistry Concept Inventory.

Laboratory Skills: Rubric-based assessment of titration and qualitative analysis procedures scored 0–10.

Engagement: Intrinsic Motivation Inventory plus system logs: time-on-task, number of hints requested, and error recovery rate.

Qualitative: Semi-structured interviews with 15 students from the experimental group.

Analysis

Quantitative data were analyzed using SPSS v29. We ran ANCOVA on post-test scores using pre-test scores as the covariate. Effect sizes are reported as partial η^2. Qualitative interviews were coded thematically. Significance was set at $p < .05$.

Conceptual Understanding
Participants were assigned as shown in Table 1 and as shown in Table 2, Students in the experimental group showed significantly higher post-test scores than the control group.

Table 2: Comparison of Post- Test Conceptual Understanding between Groups

Measure	Control M(SD)	Experimental M(SD)	F	p	η^2
Post-test	68.4(9.2)	79.1(8.7)	18.63	<0.001	0.13

The partial η^2 of 0.13 indicates a medium effect size.

Laboratory Skills

The experimental group demonstrated better procedural accuracy and error identification: M = 8.3/10 vs. 6.9/10 for the control group, p =.003.

Engagement and System Interaction

Time-on-task: The experimental group spent 23% more time in self-directed exploration within the virtual lab.
Hint Efficiency: Students resolved 74% of errors after 1–2 AI hints, compared to 41% resolution with TA support in the control group.
Stimulation Events: In interviews, 89% of students said the AI's anomalies "made me think harder".

Qualitative Findings

Three main themes emerged from interviews:
1. Safety and Confidence: "I tried the reaction 5 times without fear."
2. Personalized Pace: "The AI didn't judge me when I asked basic questions."
3. Concept Linking: "The 'why did this fail' hints helped me connect theory to what I was doing."

Findings and Discussion

Interpretation of Findings

The gains in conceptual understanding align with VanLehn's finding that intelligent tutoring systems can approach the effectiveness of human tutors. Our framework goes further by focusing on cognitive provocation. By introducing controlled anomalies, the system uses "productive failure" a strategy known to deepen learning and transfer. Students did not just get the right answer; they had to wrestle with why an unexpected result occurred.

AI *vs* Traditional Virtual Labs

Unlike the static simulations described by Tatli & Ayas, our AI provided feedback that depended on the student's specific action. The 74% error recovery rate after minimal hints suggests that LLM-based Socratic dialogue scaffolds learning better than a generic "try again" message.

Implications for Chemistry Education

1. **Access**: This approach reduces dependence on costly infrastructure, supporting digital education goals like India's NEP 2020.
2. **Safety**: Students can explore hazardous reactions that are banned from undergraduate labs, building intuition without physical risk.
3. **Differentiation**: The learner model lets advanced students attempt extensions while giving struggling students more support.

A key concern is whether virtual practice reduces respect for safety. Our data suggest the opposite. Students who experimented freely in VR were more methodical in their single physical lab session, because they already understood failure modes. The AI built competence first, which reinforced caution.

Limitations

This study has limits. It was conducted at a single institution, which affects generalizability. The 6-week period may have produced a novelty effect. The AI also occasionally misdiagnosed rare misconceptions. Finally, no student data were used to train the underlying language model, and all interactions were anonymized to protect privacy.

Future Work

Next steps include integrating augmented reality for hybrid physical-virtual labs and training the LLM on a wider range of Indian university curricula. A multi-institutional randomized controlled trial is planned to test long-term retention.

Conclusion

This study introduced and evaluated an Intelligent Stimulation Framework for AI-powered virtual chemistry laboratories. Unlike traditional simulations that primarily demonstrate procedures, this framework was designed to provoke thinking by embedding adaptive challenges, controlled anomalies, and Socratic dialogue into the learning experience. Our findings from 127 undergraduate chemistry students show that the approach is effective. Students who used the AI virtual lab demonstrated significantly higher conceptual understanding and improved laboratory skills compared to peers in traditional labs. They also spent more time in self-directed exploration and resolved errors more efficiently with AI hints. Qualitative data revealed that the system built confidence, supported individual pacing, and helped students connect theoretical concepts to experimental practice.

The broader implication is clear: AI-powered virtual labs can serve as powerful partners to physical laboratories. They provide a safe space for students to fail, repeat, and reflect without the constraints of cost, safety, or equipment availability. This is especially relevant for institutions working toward digital education goals, such as those outlined in India’s NEP 2020. However, these systems are not a replacement for hands-on work. Physical laboratories remain essential for developing psychomotor skills and a professional respect for chemical safety. The value of the Intelligent Stimulation Framework lies in preparing students before they enter the physical lab, ensuring they arrive with stronger conceptual foundations and greater confidence.

Several challenges remain. The fidelity of simulations for complex, multi-step reactions still needs improvement. The interpretability of AI feedback must be strengthened so instructors can trust and adapt the system. Infrastructure and faculty training are also critical for scalable adoption.

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The Impact of AI-Assisted Self-Editing on Error Awareness in English Sentence Writing: A Case Study of a Vietnamese University

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Abstract

Artificial intelligence (AI) is increasingly shaping educational practices, particularly in the teaching and learning of writing at the tertiary level. In the Vietnamese context, although tools such as ChatGPT are becoming more accessible, their pedagogical integration into English-majored writing classes remains limited and underexplored. This study explores students' perceptions of AI-assisted self-editing and its potential to enhance error awareness in English sentence writing, based on a case study at a Vietnamese university. A descriptive survey design was employed with 58 undergraduate English-major students who engaged in guided self-editing activities using ChatGPT under teacher instruction. Data were collected using a structured questionnaire that examined perceived usefulness, ease of use, error awareness, self-editing confidence, and perceived limitations. The findings indicate that students generally hold positive perceptions of ChatGPT, particularly regarding its usefulness and accessibility. Students also reported increased awareness of grammatical errors and greater engagement in reflecting on their mistakes. In addition, the use of ChatGPT was associated with improved confidence and a growing sense of autonomy in revising writing. However, concerns were raised regarding feedback accuracy and overreliance on AI. Overall, the study highlights the potential of AI-assisted self-editing to promote more reflective, learner-centered writing practices in Vietnamese higher education.

Keywords: AI-Assisted Self-Editing, ChatGPT, EFL Writing, Error Awareness, Learner Autonomy

Introduction

The integration of artificial intelligence (AI) into education has substantially transformed teaching and learning practices, particularly within language education. Recently, AI-powered tools such as ChatGPT have been increasingly utilized in writing instruction, providing immediate feedback, error correction, and revision suggestions (Kasneci et al., 2023). These capabilities offer new opportunities for interactive, individualized learning, particularly in developing writing skills. Within English as a Foreign Language (EFL) education, writing is among the most challenging skills for learners, especially at the sentence level (Hyland, 2019). Grammatical features such as verb tense, subject–verb agreement, and article usage present persistent difficulties. According to Bitchener and Ferris (2012), these error types are challenging to master due to complex rule systems and first language transfer. In Vietnam, writing instruction at many universities, including Vinh Long University of Technology Education, has traditionally relied on teacher-

centered feedback, with students largely passive in identifying and correcting errors. Such approaches may limit learners' opportunities to reflect on their writing and develop independent self-editing skills. (Escalante et al., 2023) Recently, AI tools have been conceptualized as mediating resources that can transform feedback delivery and utilization. Rather than serving a corrective function solely, these tools enable learners to receive immediate, personalized responses and to participate more actively in revision. Ranalli (2021) suggests that technology-mediated feedback can promote learner interaction with feedback and revision, although the degree of engagement and self-regulation depends on how learners respond to and utilize the feedback. In the Vietnamese EFL context, emerging research has identified both opportunities and challenges associated with integrating tools such as ChatGPT, particularly regarding student engagement and perceptions (Le et al., 2024). However, most existing studies focus on writing outcomes, with limited exploration of how learners experience and interpret AI-supported feedback. Specifically, there remains insufficient understanding of how AI may assist learners in noticing and comprehending grammatical errors during revision. Addressing this gap is crucial for developing a comprehensive understanding of AI-assisted self-editing as a learner-centered practice.

Rationale of the Study

Although there is increasing interest in AI-assisted language learning, the integration of tools such as ChatGPT into writing instruction within Vietnamese higher education remains limited and lacks a systematic structure. At Vinh Long University of Technology Education, English-major students are exposed to AI technologies with growing frequency; however, their usage is predominantly informal and is not supported by explicit pedagogical frameworks. As a result, the potential of these tools to facilitate meaningful learning in writing has not been fully realized.

In the Vietnamese context, existing research has primarily focused on students' general perceptions of ChatGPT, particularly its usefulness for idea generation and error correction (Le et al., 2024). Although these studies offer valuable insights, they provide limited examination of how learners interact with AI during the revision process. Specifically, there is a lack of research on students' perceptions of ChatGPT for self-editing and its contribution to developing sentence-level error awareness. This gap is significant when considered in relation to the Noticing Hypothesis (Schmidt, 1990), which underscores the necessity of conscious attention in language acquisition. Effective learning requires that learners not only receive feedback but also actively notice and comprehend their errors. Self-editing is essential in this context, as it encourages learners to reflect on their writing and assume responsibility for improvement (Hyland, 2019). However, many Vietnamese EFL learners continue to depend heavily on teacher feedback and may lack both the confidence and strategies required for independent revision (Huy & Ngoc, 2024).

Given these considerations, it is necessary to examine how students perceive AI-assisted self-editing and whether guided use of ChatGPT enhances their awareness of grammatical errors, confidence in revision, and overall learning experience. By focusing on English-major students at Vinh Long University of Technology Education, this study provides context-specific insights into the meaningful integration of AI in writing instruction. The findings aim to contribute to a nuanced understanding of AI-assisted learning and to inform the development of reflective, learner-centered writing practices in Vietnamese higher education.

Review of Related Literature

AI in L2 Writing Instruction

The integration of artificial intelligence (AI) in second language writing instruction has received increasing scholarly attention. AI technologies, such as ChatGPT, provide immediate and individualized feedback to students, in contrast to the delayed and often limited responses typically offered by teachers (Kasneci et al., 2023). These tools help learners identify and correct errors and understand the underlying reasons for their mistakes. By offering corrections, explanations, and alternative expressions, AI tools enable more efficient revision and foster greater engagement with the writing process. (Yang et al., 2024) Recent research has emphasized the pedagogical value of generative AI in language learning, particularly its capacity to reform feedback practices and create personalized learning environments (Tlili et al., 2023). In the context of second-language writing, AI tools have been shown to facilitate interactive, adaptive revision processes, allowing learners to engage with feedback in more meaningful ways (Warschauer & Grimes, 2024). For example, Zhai (2023) demonstrates that AI tools can create interactive, adaptive learning environments, enabling learners to receive real-time feedback and revise their writing incrementally. Similarly, Li et al. (2023) argue that AI-generated feedback encourages greater learner involvement by prompting students to interact with and revise their writing, although the degree of engagement may depend on how learners utilize the feedback. Collectively, these findings indicate that AI tools not only enhance writing performance but also promote more dynamic and learner-centered approaches to writing instruction (An, 2025).

In addition to the quality of feedback, learners' perceptions and utilization of AI tools significantly influence the effectiveness of AI-assisted writing. Learner attitudes, including perceived usefulness, ease of use, trust in feedback, and concerns regarding overreliance, are critical in shaping engagement with AI-supported learning (Zhai, 2023; Le et al., 2024). Positive perceptions are generally associated with more active engagement with feedback and a greater willingness to revise, whereas uncertainty or scepticism may restrict meaningful use. Consequently, understanding students' perceptions is essential for evaluating the pedagogical value of AI in writing instruction. Rather than viewing AI solely as a tool for improving writing outcomes, recent studies emphasize the importance of considering how learners experience and interpret AI-supported feedback throughout the learning process. (Yang et al., 2023) This perspective is particularly pertinent in contexts such as Vietnamese EFL classrooms, where AI integration is still emerging, and learners may require guidance to use these tools effectively.

Error Awareness and the Noticing Hypothesis

Error awareness constitutes a fundamental aspect of second language acquisition, particularly in the development of writing skills, as it enables learners to distinguish between their current language use and target forms. In the writing process, individuals make ongoing decisions regarding grammar, vocabulary, sentence structure, and the organization of ideas. When learners become aware of their errors, they are more likely to reflect on the underlying causes and consider strategies for improvement. This reflective process fosters deeper engagement with the language, moving beyond mechanical correction of mistakes. Consequently, learners are more likely to internalize and retain linguistic knowledge, rather than merely correcting errors temporarily. The

Noticing Hypothesis posits that conscious attention to linguistic forms in input is necessary for acquisition to occur (Schmidt, 1990). Thus, exposure to correct language forms alone is insufficient; learners must actively notice and focus on specific features, particularly those that differ from their existing knowledge. Schmidt (1990) differentiates between input, intake, and learning, asserting that only consciously noticed linguistic features become intake and are subject to internalization. In the context of writing, effective feedback requires that learners first identify the presence of an error (noticing), comprehend the reason for its incorrectness (awareness), and subsequently apply the correct form in future writing tasks (learning). Absent this process of noticing and understanding, feedback may result only in superficial correction, offering limited benefit for long-term language development. (Mackey, 2006) Subsequent research supports this perspective, emphasizing that conscious attention to form is essential for transforming input into intake and promoting language development (Leow, 2015; Godfroid et al., 2013).

Feedback is most effective when it encourages learners to actively engage with their errors rather than passively accept corrections. Self-editing is essential in this process, as it requires learners to identify, analyze, and revise their own errors. Hyland (2019) argues that developing writing skills involves not only improving grammatical accuracy but also fostering learners' awareness of language use, enabling them to reflect on and manage their own language more effectively. The effectiveness of noticing is further influenced by cognitive and affective factors, including attention, motivation, and confidence. Learners are more likely to attend to feedback when they actively participate in the revision process and perceive the learning activity as useful and meaningful. (Pham, 2021) Tools that provide immediate and interactive feedback, such as AI-assisted writing systems, can enhance the noticing process by offering learners opportunities to revisit errors, reflect on them, and make real-time revisions. Recent studies indicate that interactive feedback environments promote deeper cognitive processing and sustained attention to language forms (Godfroid et al., 2013). Therefore, the Noticing Hypothesis provides a valuable framework for understanding how AI-assisted self-editing can foster learners' error awareness. By enabling students to interact with feedback, identify their own mistakes, and reflect more critically on their language use, AI tools such as ChatGPT can promote active engagement in the learning process and foster deeper, more meaningful language development.

AI-Assisted Self-Editing in Writing

Recent research has increasingly examined the potential of artificial intelligence (AI) tools to support self-editing practices in second language writing. Specifically, AI-assisted self-editing allows learners to engage with feedback dynamically, revise their writing through multiple iterations, and explore alternative forms of expression. This approach aligns with the concept of technology-mediated corrective feedback, which provides timely, individualized support to learners. Ranalli (2021) notes that digital feedback tools can foster more active engagement by enabling learners to test hypotheses, receive immediate responses, and refine their language use through repeated interaction. Similarly, Li et al. (2023) found that AI-generated feedback can promote learner engagement when students actively process corrections and make iterative improvements to their writing. Recent studies further indicate that AI-generated feedback can improve both writing quality and learner engagement, particularly when students interact actively with feedback rather than passively accept corrections (Wang & Han, 2023; Yan et al., 2024).

The effectiveness of AI-assisted self-editing depends not only on the availability of feedback but also on the manner in which learners engage with it. While AI tools can provide accurate corrections and explanations, learners may become overly reliant on these tools without fully understanding the underlying grammar rules. This issue has been previously identified in research on automated writing evaluation systems, which indicates that learners sometimes accept corrections without reflection, potentially limiting deeper learning (Stevenson & Phakiti, 2014). Therefore, AI-assisted feedback is unlikely to be effective unless learners actively process and comprehend the feedback provided.

In this context, learners' perceptions of AI tools are particularly influential in determining the effectiveness of AI-assisted feedback. According to Zhai (2023), factors such as perceived usefulness, ease of use, and trust in AI-generated feedback shape how learners interact with these tools and the extent of their benefit. When learners regard AI as helpful and reliable, they are more likely to engage deeply with feedback and utilize it as a learning resource rather than merely a source of correction. More broadly, generative AI is increasingly conceptualized as a collaborative partner in learning, enabling learners to co-construct knowledge through ongoing interaction with AI systems (Mollick, 2024).
Collectively, these perspectives indicate that AI-assisted self-editing should be regarded not only as a technological innovation but also as a learner-centered pedagogical practice. The effectiveness of this approach depends on students' attitudes, engagement levels, and learning strategies. Consequently, examining learners' perceptions of AI use is essential for determining effective integration into writing instruction and for supporting deeper learning processes, including reflection, error awareness, and learner autonomy.

AI in Vietnamese EFL Writing Contexts

In Vietnam, the integration of artificial intelligence (AI) into language education remains in its early stages. Writing instruction at many universities continues to emphasize teacher-centered feedback, with students relying extensively on instructors for error correction (Nguyen & Tran, 2020). While this method addresses errors, it may restrict students' development of independent revision skills and metacognitive awareness. A significant limitation of teacher-centered feedback is its tendency to foster passive learning behaviours. When corrections are provided directly, students often concentrate on producing the correct form rather than understanding the underlying causes of their errors. Previous research indicates that learners in these contexts frequently depend on explicit correction and may not actively analyze or reflect on their mistakes (Littlewood, 1999; Nguyen & Gu, 2013). Consequently, students have fewer opportunities to cultivate self-regulated learning strategies, such as independently reviewing their writing and evaluating language use.

Teacher-centered approaches can constrain the development of metacognitive awareness, defined as learners' ability to reflect on and manage their own learning processes (Al-Azzam, 2024). When feedback is primarily provided by teachers, students may become less confident in editing their own writing and may lack experience in independently identifying grammatical errors (Ranalli, 2021). Such outcomes are often associated with classroom practices that prioritize teacher authority and correct answers over learner independence, thereby impeding students' ability to plan, monitor, and evaluate their own writing effectively (Duong, 2014).

Recent studies in the Vietnamese context indicate that students often engage with feedback at a surface level, focusing on error correction without fully understanding the underlying issues (Le et al., 2024). This surface-level engagement may hinder long-term language development, as learners are more likely to repeat the same mistakes in future writing tasks. Furthermore, when students are not actively involved in the feedback process, they may struggle to transfer learned concepts to new writing situations. These limitations suggest that traditional feedback practices may not effectively foster deeper cognitive engagement or support the development of independent revision skills. In contrast, learner-centered approaches, such as AI-assisted self-editing, can offer greater opportunities for active participation, reflection, and the cultivation of learner autonomy (Benson, 2013). By enabling students to interact with feedback and revise their writing iteratively, these methods may facilitate deeper learning. However, research remains limited regarding Vietnamese students' perceptions of AI use in this context, particularly concerning error awareness and sentence-level writing. This gap indicates a need for further research into student perceptions of AI-assisted self-editing within specific educational contexts, such as among English-major students at Vinh Long University of Technology Education. A clearer understanding of these perceptions could enable educators to develop more effective and learner-centered approaches for integrating AI into writing instruction.

Research Questions

Based on the aims of the study, the following research questions are formulated to explore students' perceptions of AI-assisted self-editing and its role in supporting error awareness in English sentence writing:

1. How do English-major students perceive the use of AI-assisted self-editing (ChatGPT) in English sentence writing?
2. How do students perceive the role of AI-assisted self-editing in enhancing their awareness of grammatical errors?
3. How does AI-assisted self-editing influence students' confidence and autonomy in revising their own writing?
4. What benefits and challenges do students perceive when using ChatGPT for self-editing in writing?

Methodology

Research Design

A descriptive survey research design was employed to investigate students' perceptions of AI-assisted self-editing and its contribution to enhancing error awareness in English sentence writing. Instead of assessing learning outcomes through comparative analysis or testing, the study prioritizes the exploration of students' experiences, attitudes, and self-reported learning following participation in guided self-editing activities with ChatGPT. The research design centers on the collection of self-reported data via a structured questionnaire, facilitating the examination of students' perceived abilities to identify errors, interpret feedback, and build confidence in revising their own writing.

Participants

The study sample comprised 58 first-year undergraduate students majoring in English at Vinh Long University of Technology Education. These students demonstrated comparable levels of English proficiency, as indicated by their educational backgrounds and current academic programs. All participants engaged in identical AI-assisted self-editing activities during the research. Participation was voluntary, and students received

information regarding the research objectives prior to data collection. Confidentiality and anonymity were upheld throughout the research process.

Instruments

To collect data, the study employs the following instruments:

Guided Self-Editing Tasks

Students complete a series of sentence-writing tasks designed to practice common grammatical structures, including:

- verb tense
- subject–verb agreement
- article usage
- sentence structure

These tasks serve as the basis for students' interaction with ChatGPT during the self-editing process.

Analysis

Error Awareness Questionnaire

A structured questionnaire employing a five-point Likert scale is administered following the self-editing activities. This instrument measures students' perceptions in four primary domains:

- Error awareness: ability to identify and understand grammatical errors
- Grammatical understanding: awareness of language rules and corrections
- Self-editing confidence: confidence in revising writing independently
- Perceptions of AI use: usefulness, ease of use, and limitations of ChatGPT

Several open-ended questions are also included to gather deeper insights into students' experiences and opinions.

Optional Reflective Notes

As part of the self-editing process, students may be required to write brief reflections on their learning experiences, including the types of errors they identified and insights gained from ChatGPT feedback. These reflections provide supplementary qualitative data for the study.

Ethical Considerations

Participants receive information regarding the study's purpose and are advised of their right to withdraw at any time. Data collection is conducted anonymously and exclusively for research purposes. Personal identifying information remains undisclosed.

Findings and Discussion

The questionnaire results offer a comprehensive overview of students' perceptions of AI-assisted self-editing with ChatGPT in five key areas: perceived usefulness, ease of use, error awareness, self-editing confidence, and perceived limitations. Section A (Perceived Usefulness) indicates that students hold generally positive views regarding the usefulness of ChatGPT in supporting English sentence writing. Mean scores range from 3.64 to 3.84, reflecting overall agreement among participants. The statement "Using ChatGPT improves my English sentence writing" achieved the highest mean score ($M = 3.84$, $SD = 0.93$), while "ChatGPT helps me correct grammatical errors effectively" received a slightly lower mean ($M = 3.64$, $SD = 0.91$). The relatively low standard deviation values

(SD = 0.81-0.93) indicate that students' responses are consistent, suggesting a shared perception of ChatGPT as a beneficial tool for writing support.

Section B reveals a similar pattern, focusing on students' perceptions of ChatGPT's ease of use. Participants generally rate ChatGPT as accessible and user-friendly, with mean scores between 3.67 and 3.91. The statement "It is easy to interact with ChatGPT when revising my writing" receives the highest rating (M = 3.91, SD = 0.95), indicating that most students feel comfortable using the tool during revision. In contrast, "I find it easy to understand the feedback provided by ChatGPT" receives the lowest mean score (M = 3.67, SD = 1.00), suggesting that while ChatGPT is considered easy to use, interpreting its feedback may present challenges. The relatively higher standard deviation values (SD = 0.92-1.00) further indicate variability in students' experiences with the tool.

More importantly, the results from Section C highlight the role of ChatGPT in enhancing students' error awareness. All items in this section receive high mean scores, ranging from 3.83 to 3.95, reflecting strong agreement among participants. Specifically, students report increased awareness of common grammatical mistakes (M = 3.95, SD = 0.98) and a greater ability to reflect on their errors (M = 3.95, SD = 0.91). Although the statement "I can identify errors more easily after using ChatGPT" has a slightly lower mean (M = 3.83, SD = 0.84), the overall findings indicate that ChatGPT facilitates both error identification and deeper reflection on language use, increasing confidence and autonomy in the self-editing process. The mean scores range from 3.33 to 4.09, reflecting overall agreement among the participants. In particular, students show a strong willingness to revise their writing after receiving feedback (M = 4.09, SD = 0.94) and report a greater sense of responsibility for improving their work (M = 3.97, SD = 0.90). However, the item "I rely less on my teacher to correct my errors" receives the lowest mean score (M = 3.33, SD = 1.09). This reflects that although students feel more confident in revising their writing, they still consider teacher support important. The relatively higher variation in responses for this item also indicates that students differ in the extent to which they depend on teacher feedback.

Section E demonstrates that students recognize several limitations associated with ChatGPT. Mean scores range from 3.52 to 4.45, reflecting moderate to strong agreement. The highest-rated item, "ChatGPT cannot fully replace teacher feedback" (M = 4.45, SD = 1.02), indicates that students continue to view teachers as essential. Students also acknowledge the importance of teacher guidance (M = 4.00, SD = 1.14) and report some uncertainty regarding the accuracy of AI-generated feedback (M = 4.07, SD = 1.15). While concerns about overreliance exist (M = 3.52, SD = 1.23), they are less pronounced. The higher standard deviation values in this section suggest greater variability in students' perceptions, particularly concerning trust in AI tools.

The responses to open-ended Questions 26–29 offer deeper insight into students' experiences with ChatGPT during the self-editing process. Overall, students recognize both the strengths and limitations of the tool. Many participants describe ChatGPT as fast, convenient, and effective for correcting errors. Immediate feedback is frequently cited as a key advantage, enabling students to revise their writing more efficiently. Students also report that ChatGPT helps identify grammatical mistakes, detect minor errors, and provide suggestions for sentence improvement. Some participants note that the tool supports the production of more natural and accurate sentences, facilitates appropriate vocabulary selection, and enhances understanding of grammar structures. However,

students also identify several challenges. A common concern is that ChatGPT does not always fully interpret user intent, occasionally resulting in unclear or irrelevant responses. Some students question the accuracy and reliability of the feedback, particularly when explanations differ from those provided by teachers. Additionally, several participants indicate that certain explanations are difficult to understand due to their generality or complexity. Although less frequently mentioned, technical issues such as limited access to advanced features and the requirement for stable internet connectivity are also perceived as disadvantages.

The impact of ChatGPT on writing practices reveals both positive and mixed outcomes. Many students report improved accuracy, heightened error awareness, and a more efficient revision process. Some also note increased confidence and a better understanding of sentence structure. However, these advantages are not universal. Certain students experience only moderate improvement, while others express concerns about overreliance on the tool or reduced independent thinking. In some cases, students report decreased confidence in their writing abilities when unable to use ChatGPT effectively. Overall, the results indicate that students generally perceive ChatGPT as a valuable support tool for writing. They appreciate its ease of use, speed, and ability to highlight errors, which contributes to greater confidence during revision. Nevertheless, students also acknowledge its limitations, particularly in terms of accuracy and clarity, and recognize the potential risk of excessive dependence. These findings suggest that ChatGPT can enhance writing and error awareness, but its effectiveness depends on appropriate usage. The tool appears most beneficial when combined with teacher guidance, which promotes deeper understanding and more meaningful application of feedback.

This study investigates English-major students' perceptions of using ChatGPT for AI-assisted self-editing and examines the relationship between these perceptions and their awareness of grammatical errors in sentence writing. The results indicate that students generally hold positive attitudes toward ChatGPT, although notable differences exist in their engagement with AI-generated feedback. These findings suggest that AI tools can facilitate writing development by offering corrections and suggestions and by promoting more active student participation in the revision process. It should be noted that these conclusions are based on students' self-reported perceptions rather than on direct measures of learning outcomes.

AI-Assisted Self-Editing and the Noticing Hypothesis

A key finding of this study is that a substantial proportion of students strongly agreed that ChatGPT increased their awareness of errors in writing. Participants reported that the tool not only facilitated the identification of mistakes but also prompted consideration of the underlying causes and potential improvements. These results indicate that AI-assisted self-editing extends beyond basic error correction and fosters more active engagement with language. Theoretically, this outcome aligns with the Noticing Hypothesis (Schmidt, 1990), which posits that conscious attention to language forms is essential for learning. In the present study, ChatGPT appears to facilitate this process by enabling students to recognize discrepancies between their own writing and more accurate language forms. The immediacy of feedback allows students to revise their sentences as the learning process continues. Furthermore, the relatively high ratings for items related to understanding and reflection suggest that students are not only noticing errors but are also engaging in deeper analysis of those errors. Thus, ChatGPT may support learning by

creating opportunities for reflection and deeper understanding, rather than solely correcting mistakes.

AI, Engagement, and Emerging Learner Autonomy

In addition to error awareness, the findings underscore the influence of ChatGPT on students' engagement with the writing process. Students generally perceived the tool as both useful and easy to use, which appears to reduce barriers to participation and foster more frequent engagement with feedback. This is particularly evident in the high willingness to revise, indicating that students are not only receiving feedback but are also motivated to implement it. These results align with the framework of AI-supported learning, in which technologies enhance engagement by providing immediate, personalized, and interactive feedback (Ranalli, 2021; Zhai, 2023). Recent studies further indicate that AI can serve as an active learning partner, prompting learners to participate in iterative revision and deeper processing of feedback (Warschauer & Grimes, 2024; Mollick, 2024). In the present study, these features appear to facilitate a more active learning process, characterized by iterative revision rather than single-instance correction. In summary, the findings regarding learner autonomy present a nuanced perspective. While students reported increased confidence and a heightened sense of responsibility for improving their writing, they did not express a significant reduction in dependence on their teachers. These results suggest that learner autonomy is developing incrementally rather than supplanting traditional instructional support. Thus, students are becoming more proactive in managing their learning while continuing to acknowledge the essential role of teacher guidance.

Trust, Limitations, and the Need for Guided Use

While students generally perceived ChatGPT positively, the findings also reveal several concerns that warrant attention. Some students expressed uncertainty regarding the accuracy of ChatGPT's feedback, and others reported difficulty understanding certain explanations. These concerns are significant because they may affect how students engage with and respond to AI-generated feedback. Notably, many students strongly agreed that ChatGPT cannot fully replace teacher feedback. This indicates that students regard AI as a valuable support tool, but not as a substitute for teachers. Students continue to depend on teachers for clearer explanations, validation, and deeper understanding during the revision process. This observation reinforces the notion that AI, despite its capabilities, does not fully replicate the pedagogical sensitivity of human instructors. Furthermore, variation in responses regarding overreliance indicates that students do not engage with AI uniformly. This finding is consistent with recent studies showing that learner engagement with AI-generated feedback varies considerably, with some students adopting a critical approach and others employing more passive strategies (Yan et al., 2024). Some students use ChatGPT as a learning tool, carefully considering feedback and reflecting on their errors, whereas others use it primarily for rapid error correction. This distinction highlights a key challenge in AI-supported education: the effectiveness of AI depends not only on the technology itself, but also on learners' approaches to its use. Consequently, the findings underscore the importance of guided integration, in which teachers assist students in critically interpreting feedback, verifying the accuracy of corrections, and understanding the underlying language rules.

Implications for the Vietnamese EFL Context

These findings are particularly significant in the Vietnamese EFL context, where writing instruction has traditionally followed teacher-centered practices. Previous studies indicate

that students often depend heavily on teacher feedback and possess limited experience with independent revision. The positive perceptions of ChatGPT observed in this study suggest that AI-assisted self-editing may encourage more active and participatory learning behaviors. Increased willingness to revise, heightened error awareness, and growing confidence among students all indicate progress in this direction. Nevertheless, the ongoing reliance on teacher guidance suggests that this shift is gradual rather than transformative. In contexts where learners are not yet familiar with self-directed learning, the integration of AI should be supported by explicit instructional guidance. Teachers remain essential for helping students interpret feedback, develop critical awareness, and avoid superficial engagement. Thus, the role of AI is to complement and enhance existing pedagogical practices, fostering a more balanced learning environment that integrates technological support with human guidance.

Conclusion

This study investigated English-major students' perceptions of AI-assisted self-editing with ChatGPT and its potential to enhance error awareness in English sentence writing in a Vietnamese university context. The findings indicate that students generally perceive ChatGPT as a useful and accessible tool that supports the writing process, particularly by facilitating error identification and encouraging reflection on language use. Additionally, many students reported increased confidence and greater engagement during the revision process. Several limitations should be considered when interpreting these findings. Students raised concerns regarding the accuracy and clarity of AI-generated feedback and recognized the risk of overreliance on the tool. These concerns underscore the significance of how ChatGPT is implemented, rather than the tool itself. Greater learning potential emerges when students engage critically with feedback. The study also presents implications for teaching practice. AI tools such as ChatGPT can be effectively integrated into writing instruction to promote more active and learner-centered revision practices, while teacher guidance remains essential. Teachers play a crucial role in helping students interpret feedback critically, develop effective self-editing strategies, and avoid excessive dependence on AI-generated corrections. In educational contexts such as Vietnam, where teacher-centered approaches are prevalent, ChatGPT may facilitate a gradual transition toward increased learner autonomy. However, the findings should be interpreted with caution, as they are based on self-reported data from a relatively small sample at a single institution, which may limit generalizability. Furthermore, the study primarily addresses students’ perceptions rather than providing direct evidence of improvement in writing performance. Future research could investigate the long-term effects of AI-assisted self-editing on actual writing development and examine how various teaching approaches influence students’ engagement with AI-generated feedback.

In conclusion, ChatGPT demonstrates potential as a supportive tool for developing writing skills and enhancing error awareness. Its effectiveness, however, relies on thoughtful integration into instructional practices and active learner engagement. When appropriately utilized, ChatGPT can foster more reflective and independent learning in English as a Foreign Language (EFL) writing contexts.

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Artificial Intelligence-Supported Project-Based Learning for Enhancing Students' Digital Engagement in Remote Schools

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Abstract

The integration of artificial intelligence (AI) into education has created new opportunities for supporting interactive and student-centered learning environments. However, the implementation of AI-supported learning in remote island schools remains challenging due to limited technological infrastructure, restricted access to digital resources, and unequal learning opportunities. This study aims to examine the implementation of Artificial Intelligence-Supported Project-Based Learning (AI-Supported PjBL) and explore its role in enhancing students' digital engagement in a remote island school context. The study employed a mixed-method approach involving 30 junior high school students in a small island school on Lae-Lae Island, Indonesia. Learning activities were implemented through contextual project-based learning integrated with AI-assisted digital tools for information exploration, project planning, and digital content creation. Quantitative data were collected using a digital engagement questionnaire covering cognitive, emotional, and behavioural engagement dimensions, while qualitative data were obtained through classroom observations, interviews, and project documentation. The findings revealed that students demonstrated relatively high levels of digital engagement during AI-supported project activities, with cognitive engagement showing the highest percentage (76.23%), followed by emotional engagement (76.02%) and behavioural engagement (75.55%). Qualitative findings further indicated that AI-supported project activities encouraged active participation, collaborative inquiry, digital communication, and contextual problem-solving despite limitations in technological infrastructure. The study suggests that AI-Supported PjBL can provide meaningful and engaging digital learning experiences for students in geographically isolated schools and may serve as a contextual learning approach for strengthening digital participation in resource-limited educational environments.

Keywords: Contextual Learning, Digital Engagement, Project-Based Learning, Remote Island Schools, Slow Artificial Intelligence

Introduction

The rapid development of digital technology and artificial intelligence (AI) has transformed many aspects of education, including how students access information, communicate, and participate in learning activities (Chen et al., 2020; Zou et al., 2025). In recent years, AI-supported technologies such as generative AI platforms, intelligent search systems, and digital content creation tools have increasingly been integrated into classroom practices to support inquiry, collaboration, and problem-solving (Tong et al., 2025). These technologies are considered to have the potential to create more interactive and student-centered learning environments, particularly in learning approaches that emphasize active participation and authentic problem-solving experiences (Artasari & Setyaningrum, 2025). Along with these developments, schools are also expected to strengthen students' engagement in digital learning activities as part of preparing learners for the demands of 21st-century education (Zou et al., 2025).

Digital engagement has become an important issue in contemporary education because students are no longer positioned merely as consumers of information but also as active participants, who interact, evaluate, and produce knowledge using digital technology (Bond et al., 2020). Digital engagement refers not only to students' ability to use technological devices, but also to their cognitive, emotional, and behavioural involvement during digital learning activities (Nahum-Shani et al., 2022). Students with high digital engagement tend to participate more actively in collaborative learning, explore information independently, communicate ideas more confidently, and demonstrate stronger persistence in completing learning tasks (Al Mamun & Lawrie, 2023). Previous studies have also shown that meaningful digital engagement contributes to learning motivation, knowledge construction, and the development of higher-order thinking skills (Wang et al., 2022).

Review of Related Literature

The growing integration of digital technology in education, many schools located in remote and geographically isolated areas continue to experience considerable challenges in implementing technology-supported learning (Ferri et al., 2020; Firdaus & Ritonga, 2024). Schools in island regions often face limited internet connectivity, inadequate digital infrastructure, restricted access to learning resources, and a shortage of technology-based instructional support (Harahap et al., 2025). These conditions may reduce students' opportunities to interact meaningfully with digital learning environments and frequently result in technology being used only for basic communication or entertainment purposes rather than as a tool for inquiry and knowledge construction (Al Mamun & Lawrie, 2023). In many cases, learning activities in remote schools also remain dominated by teacher-centered instruction, limiting opportunities for students to engage in collaborative exploration and problem-solving activities (De Jong et al., 2022; Le et al., 2018).

The challenges experienced by remote island schools indicate the need for learning approaches that are not only technology-oriented but also contextual and adaptable to local conditions (Hesti Putri et al., 2025). One learning approach that has been widely recognized for promoting active learning and authentic problem solving is Project-Based Learning (PjBL) (Chistyakov et al., 2023; Guo et al., 2020). Through project activities, students are encouraged to investigate real-world problems, collaborate with peers, and develop solutions that are relevant to their surrounding environment (Evains et al., 2024; Rehman et al., 2023). PjBL also provides opportunities for students to integrate digital

technology into inquiry activities, communication, and the creation of learning products. In the context of remote schools, project-based learning may help students connect classroom learning with local environmental and social issues that are closely related to their daily experiences (Nurhidayati et al., 2024).

Recent developments in artificial intelligence further expand the possibilities of project-based learning implementation (Ruiz Viruel et al., 2025). AI-supported learning tools can assist students in searching for information, generating ideas, organizing project plans, creating digital artifacts, and reflecting on learning processes (Pesovski et al., 2024). Rather than replacing the role of teachers, AI technologies may function as cognitive scaffolding tools that support students during inquiry and project activities. AI-supported learning environments may also encourage students to participate more actively in digital learning activities because students are provided with immediate access to information, interactive feedback, and flexible opportunities for exploration (Yaseen et al., 2025). However, most studies examining AI integration in education have been conducted in urban or technologically well-equipped schools, while research focusing on remote island contexts remains limited.

Objectives

The purposes of this project-based learning in remote schools have primarily emphasized learning outcomes such as academic achievement, digital literacy, or critical thinking skills. Comparatively fewer studies have explored how AI-supported project-based learning facilitates students' digital engagement during the learning process itself. Understanding digital engagement is important because engagement reflects how students cognitively, emotionally, and behaviourally interact with digital learning experiences. Investigating these aspects may provide a deeper understanding of how AI-supported learning can function effectively in schools with limited technological resources.

Therefore, this study examines the implementation of Artificial Intelligence-Supported Project-Based Learning (AI-Supported PjBL) in a remote island school context and explores how this learning approach facilitates students' digital engagement during project activities. By focusing on students' participation in AI-assisted inquiry, collaboration, digital communication, and project development, this study seeks to contribute to the growing discussion regarding the role of AI in contextual and resource-limited educational environments. The findings are expected to provide insights into how AI-supported project-based learning can create more meaningful and engaging digital learning experiences for students in geographically isolated schools.

Methodology

Research Design

This study employed a mixed-method approach using an embedded design to examine the implementation of Artificial Intelligence-Supported Project-Based Learning (AI-Supported PjBL) in a remote island school context and to explore its influence on students' digital engagement during learning activities. The mixed-method approach was selected to provide a more comprehensive understanding of how students participated cognitively, behaviourally, and emotionally in AI-supported project activities. Quantitative data were used to identify patterns of students' digital engagement during the learning intervention, while qualitative data were utilized to describe students' learning experiences, participation, and interactions throughout the project process.

The study was conducted during the implementation of project-based learning activities integrated with AI-assisted digital tools. Learning activities were designed to encourage students to explore contextual problems found in their surrounding environment and develop collaborative digital project products. Artificial intelligence tools were utilized as learning support systems during information exploration, idea generation, project planning, and digital content development.

Research Site and Participants

The research was conducted at a junior high school located on Lae-Lae Island, Makassar, Indonesia. Lae-Lae Island is categorized as a small island area with limited educational infrastructure and constrained access to digital technology compared to urban schools. Internet connectivity in the area is relatively unstable, and the availability of digital learning resources remains limited. Most students come from families whose primary occupations are related to fishing and informal economic sectors.

Participants in this study consisted of 30 lower secondary school students who were involved in the implementation of AI-Supported PjBL activities. The participants were selected purposively based on their involvement in project-based learning activities and their accessibility to basic digital devices during the learning process. In addition, several teachers participated as facilitators during the implementation of project activities and contributed to qualitative observations regarding students' engagement during learning.

Learning Intervention

The learning intervention was implemented through a series of contextual project-based learning activities integrated with the use of AI-supported digital tools. The projects were developed based on environmental and social issues relevant to students' daily lives in island communities, including waste management, clean water availability, coastal environmental problems, and local energy use.

The implementation of AI-Supported PjBL consisted of several stages: contextual problem identification, collaborative project planning, AI-assisted information exploration, project development, digital product presentation, and reflection. During the information exploration stage, students used AI-supported tools to search for information, generate project ideas, summarize learning materials, and develop digital content. Students also utilized digital platforms to create project products such as posters, presentations, short videos, and digital reports.

Throughout the learning activities, teachers functioned as facilitators who guided students in evaluating digital information, organizing project tasks, and reflecting on the learning process. AI technologies were not positioned as replacements for classroom instruction but rather as supporting tools that assisted students during inquiry and collaborative learning activities.

Instruments

Data collection was conducted using both quantitative and qualitative instruments. Quantitative data were collected through a students' digital engagement questionnaire administered after the implementation of the learning intervention. The questionnaire was developed based on three dimensions of engagement: cognitive engagement, behavioural

engagement, and emotional engagement in digital learning activities. The instrument employed a five-point Likert scale ranging from strongly disagree to strongly agree.
Cognitive engagement indicators included students' involvement in analyzing information, evaluating digital sources, and developing project ideas. Behavioural engagement focused on participation in collaborative activities, completion of project tasks, and active involvement in digital learning activities. Emotional engagement measured students' interest, motivation, confidence, and enthusiasm during AI-supported project learning.

Qualitative data were collected through classroom observations, semi-structured interviews, and documentation of students' project activities. Observations were conducted throughout the learning intervention to examine students' interactions, collaboration patterns, and participation during project activities. Interviews with students and teachers were conducted to obtain deeper insights into their experiences in using AI-supported digital tools during learning. Documentation included digital artifacts, project reports, photographs of learning activities, and students' presentation products.

Analysis

Quantitative data obtained from the digital engagement questionnaire were analyzed descriptively using mean scores, percentages, and standard deviations to identify patterns of students' engagement during AI-supported project activities. The analysis was conducted for each engagement dimension, including cognitive engagement, behavioural engagement, and emotional engagement.

Qualitative data from observations, interviews, and documentation were analyzed using thematic analysis. The analysis involved data reduction, coding, categorization, and interpretation to identify recurring patterns related to students' participation, interaction, and experiences during AI-supported project-based learning activities. The integration of quantitative and qualitative findings was conducted to provide a more comprehensive understanding of how AI-supported project-based learning facilitated students' digital engagement in the context of remote island schools.

Findings and Discussion

Students' Digital Engagement in AI-Supported Project-Based Learning

The implementation of Artificial Intelligence-Supported Project-Based Learning (AI-Supported PjBL) demonstrated positive patterns of students' engagement during learning activities in the remote island school context. Students were actively involved in various stages of project development, including identifying contextual problems, exploring digital information, discussing project ideas collaboratively, and producing digital learning artifacts. The integration of AI-supported tools within project activities also encouraged students to participate more actively in digital learning processes.

The quantitative analysis of students' digital engagement showed that all dimensions of engagement were categorized at a relatively high level. Figure 1 presents the mean percentage scores of students' cognitive engagement, emotional engagement, and behavioural engagement during the implementation of AI-Supported PjBL.

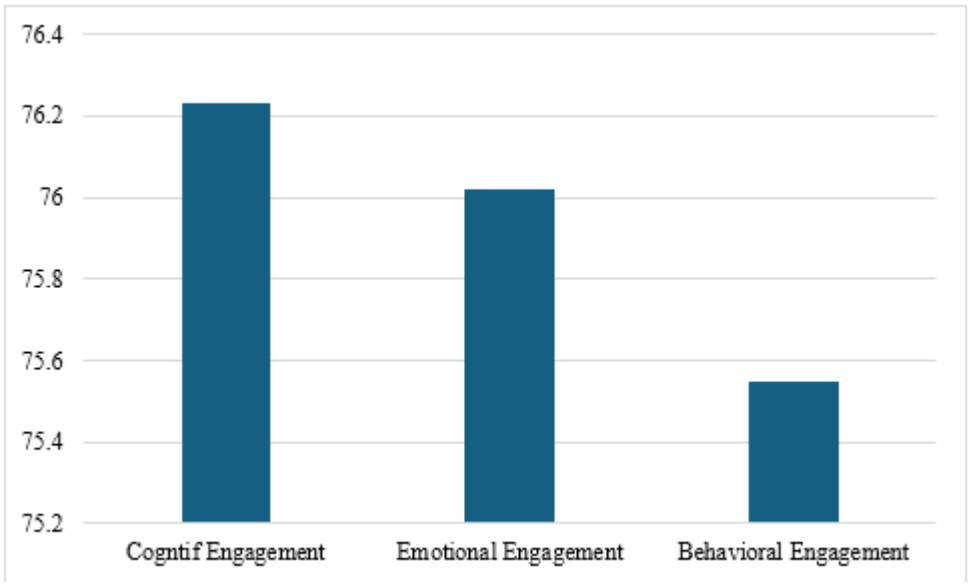

Figure 1. Students' Digital Engagement during AI-Supported Project-Based Learning

The results indicate that cognitive engagement obtained the highest percentage score (76.23%), followed by emotional engagement (76.02%) and behavioural engagement (75.55%). Although the differences among the three dimensions were relatively small, the findings suggest that students demonstrated consistent involvement across cognitive, emotional, and behavioural aspects during AI-supported project activities.

The relatively high cognitive engagement score indicates that students were actively involved in information exploration, idea generation, and problem analysis during project activities. During the learning process, students utilized AI-supported tools to search for information related to contextual environmental problems found in their surrounding communities. Students also compared information obtained from various digital sources and discussed alternative project solutions collaboratively. These activities encouraged students to become more actively engaged in inquiry-oriented learning processes rather than passively receiving information from teachers.

Emotional engagement also showed a relatively high percentage, suggesting that students experienced positive emotional involvement during learning activities. Observational findings revealed that students demonstrated enthusiasm and curiosity when interacting with AI-assisted digital tools during project development. Many students expressed increased interest in learning activities because the projects were directly connected to real problems in their local environment. The use of AI-supported applications also appeared to create a more interactive learning atmosphere, encouraging students to participate more confidently in classroom discussions and collaborative activities

Meanwhile, behavioural engagement showed that students participated actively throughout project implementation. Students were involved in collaborative discussions, project planning, digital content creation, and presentation activities. During project development, students demonstrated responsibility in completing assigned tasks and actively contributed to group activities. Several groups utilized AI-assisted platforms to organize project ideas, create presentation materials, and develop digital learning products such as posters and short videos.

The findings suggest that AI-Supported PjBL was able to facilitate students' participation in digital learning activities despite the technological limitations experienced in remote island schools. The integration of contextual projects with AI-supported inquiry activities provided opportunities for students to engage more meaningfully with digital technology during learning. Rather than functioning merely as information consumers, students became active participants who explored information, discussed ideas collaboratively, and produced digital artifacts relevant to their local environmental context.

Qualitative observations further indicated that the implementation of AI-supported project learning encouraged greater interaction among students during collaborative inquiry activities. Students frequently exchanged information, evaluated AI-generated responses, and discussed the relevance of digital information sources before integrating them into their projects. These interactions reflected not only behavioural participation but also deeper cognitive engagement during the learning process.

Although internet access and digital infrastructure remained limited in several learning sessions, students were still able to utilize available digital tools effectively with teacher guidance and peer collaboration. This finding indicates that AI-supported project-based learning may offer a flexible and contextually adaptable learning approach for promoting digital engagement in geographically isolated educational settings.

The findings of this study indicate that the implementation of Artificial Intelligence-Supported Project-Based Learning (AI-Supported PjBL) facilitated relatively high levels of students' digital engagement in the context of remote island schools. The three dimensions of engagement—cognitive, emotional, and behavioural engagement—showed consistently positive patterns during project activities. These findings suggest that the integration of AI-supported digital tools into contextual project-based learning may create more meaningful and participatory learning experiences for students living in geographically isolated areas with limited technological infrastructure.

One important finding of this study is that cognitive engagement obtained the highest percentage among the three engagement dimensions. This indicates that students were actively involved in exploring information, evaluating digital sources, discussing project ideas, and analyzing contextual problems encountered during project implementation. The use of AI-supported tools appeared to support students during inquiry activities by providing faster access to information and assisting them in generating ideas related to project development. Rather than relying solely on teacher explanations, students became more actively involved in constructing knowledge through digital exploration and collaborative problem-solving processes.

This finding aligns with previous studies suggesting that project-based learning encourages deeper cognitive participation because students are required to investigate authentic problems and develop contextual solutions through inquiry-oriented activities. In this study, AI-supported technologies strengthened this process by functioning as cognitive scaffolding tools during project implementation. Students utilized AI-assisted platforms to identify relevant information, compare alternative ideas, summarize learning materials, and organize project plans (Li & Wilson, 2025). Such activities may help students engage more deeply with learning tasks because digital tools provide flexible opportunities for exploration and knowledge construction.

The findings also demonstrate that emotional engagement remained relatively high during the implementation of AI-Supported PjBL. Students showed enthusiasm, curiosity, and increased confidence while participating in project activities and interacting with AI-assisted digital tools. This result indicates that contextual and technology-supported project activities may create more enjoyable and motivating learning experiences for students in remote educational settings. In many traditional classrooms located in resource-limited areas, learning activities are often dominated by direct instruction and routine task completion, which may reduce students' emotional involvement during learning. By contrast, project-based activities integrated with AI-supported exploration appeared to encourage students to participate more actively and confidently during classroom interaction.

The contextual nature of the projects likely contributed to students' emotional engagement. The learning activities were connected to real environmental and social issues found in students' daily lives, such as waste management, environmental problems, and local resource use (Suryawati et al., 2020). When students perceive learning tasks as relevant to their own experiences and communities, they are more likely to develop stronger emotional connections to the learning process. The integration of digital tools and AI-assisted exploration further enhanced students' interest because students experienced learning activities that differed from conventional classroom practices (Agyemang et al., 2023). This finding supports the view that meaningful and authentic learning experiences are important for promoting students' emotional involvement in digital learning environments.

Behavioral engagement also showed positive results during project implementation. Students actively participated in collaborative discussions, digital content development, project presentations, and group problem-solving activities. The implementation of AI-Supported PjBL encouraged students to become more actively involved in the learning process rather than functioning as passive recipients of information (Antony et al., 2025). During project activities, students shared responsibilities within groups, discussed project strategies, and contributed to the creation of digital artifacts such as posters, presentations, and videos. These collaborative activities promoted participation and interaction among students despite the limited educational resources available in the school environment (Omodan et al., 2024).

An important aspect emerging from this study is the role of AI-supported tools as learning facilitators rather than replacements for teachers. The findings indicate that AI technologies can function as supportive instructional resources that help students during information exploration, idea generation, and digital content development. In the present study, teachers continued to play essential roles as facilitators who guided students in evaluating information, organizing project activities, and reflecting on their learning experiences. This suggests that effective AI integration in remote schools should emphasize human-centered learning approaches in which technology supports, rather than dominates, the educational process (Ruiz Viruel et al., 2025; Wan & Hu, 2022).

The study also demonstrates that AI-supported learning may help reduce some educational limitations experienced in geographically isolated schools. Students in remote island schools often encounter restricted access to learning resources, limited exposure to digital learning environments, and inadequate technological infrastructure. Under these conditions, AI-assisted digital tools may provide alternative pathways for

accessing information and participating in inquiry-oriented learning activities. Even though internet connectivity was occasionally unstable during project implementation, students were still able to utilize available digital resources effectively through collaborative learning and teacher guidance. These findings suggest that contextual and flexible AI-supported learning models may be adapted to educational settings with constrained technological conditions.

Nevertheless, the implementation of AI-Supported PjBL also revealed several challenges. Limited internet connectivity occasionally disrupted information exploration activities, and some students initially experienced difficulties in evaluating the reliability of AI-generated information (Sun et al., 2024). In addition, differences in students' familiarity with digital tools influenced the pace of project completion among groups. These findings indicate that the integration of AI into classroom learning should be accompanied by adequate teacher facilitation, digital literacy guidance, and structured learning support to ensure that students can utilize AI technologies critically and responsibly.

The findings of this study contribute to the growing discussion regarding the use of artificial intelligence in education, particularly in underrepresented educational contexts such as remote island schools. While many studies on AI-supported learning have focused on technologically advanced or urban educational settings, this study demonstrates that AI-supported project-based learning may also provide meaningful learning opportunities in geographically isolated schools with limited resources. The study further highlights that digital engagement is not determined solely by technological availability, but also by how technology is integrated into authentic, collaborative, and contextually relevant learning activities.

Overall, the implementation of AI-Supported Project-Based Learning created learning experiences that encouraged students to participate cognitively, emotionally, and behaviourally in digital learning activities. The integration of contextual projects, collaborative inquiry, and AI-assisted exploration enabled students to interact more meaningfully with digital technology despite existing infrastructural limitations (Katsenou et al., 2025). These findings suggest that AI-supported project learning may serve as a promising approach for strengthening digital engagement in remote educational environments while also supporting more active and student-centered learning practices.

Limitations and Future Research

This study has several limitations that should be considered when interpreting the findings. First, the research was conducted in a single remote island school with a relatively small number of participants, which may limit the generalizability of the results to other educational contexts. The technological conditions, learning culture, and students' prior experiences with digital tools in other remote regions may differ from those observed in this study. Second, the implementation period of the AI-Supported Project-Based Learning activities was relatively short, making it difficult to examine the long-term development of students' digital engagement and their sustained use of AI-supported learning practices.

In addition, the study primarily focused on students' digital engagement during project activities and did not extensively investigate other important learning outcomes such as academic achievement, digital literacy growth, self-regulated learning, or critical thinking performance. The integration of AI tools in this study also functioned mainly as

instructional support rather than as a fully adaptive AI learning environment. Therefore, the findings should be interpreted within the scope of AI-assisted classroom activities in resource-limited settings.

Future studies may expand this research by involving larger samples from multiple remote schools and conducting longitudinal investigations to examine the long-term influence of AI-supported project-based learning on students' engagement and learning outcomes. Further research could also explore how different types of artificial intelligence tools contribute to students' collaboration, creativity, digital literacy, and critical thinking development. In addition, future investigations may examine teachers' readiness, ethical considerations, and digital equity issues related to AI integration in geographically isolated educational environments.

Conclusion

This study examined the implementation of Artificial Intelligence-Supported Project-Based Learning (AI-Supported PjBL) in a remote island school and explored its role in facilitating students' digital engagement during learning activities. The findings indicate that the integration of AI-supported digital tools within contextual project-based learning created positive patterns of students' cognitive, emotional, and behavioural engagement. Students actively participated in information exploration, collaborative discussions, project development, and digital artifact creation throughout the learning process.

Among the three dimensions of engagement, cognitive engagement showed the highest percentage, indicating that students were actively involved in analyzing information, evaluating digital resources, and developing project ideas during AI-supported inquiry activities. Emotional and behavioural engagement also demonstrated positive outcomes, suggesting that contextual projects integrated with AI-assisted learning tools may foster students' motivation, participation, collaboration, and confidence in digital learning environments.

The findings further suggest that AI-supported project-based learning can provide meaningful learning opportunities for students in geographically isolated schools despite limitations in technological infrastructure and access to educational resources. Rather than functioning solely as technological tools, AI-assisted platforms acted as supportive learning resources that encouraged inquiry, collaboration, and contextual problem solving during project activities. The study highlights that effective technology integration in remote schools depends not only on the availability of digital tools but also on how technology is incorporated into authentic and student-centered learning experiences.

Overall, this study contributes to the growing discussion on artificial intelligence in education by demonstrating the potential of AI-Supported PjBL to strengthen students' digital engagement in remote educational contexts. The integration of contextual project activities and AI-assisted exploration may serve as an alternative approach for promoting more active, collaborative, and meaningful digital learning experiences in resource-limited schools.

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Integrating Artificial Intelligence into Ethno-STEM Project-Based Learning to Support Students' Science Inquiry Skills in Island Schools

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Abstract

The integration of artificial intelligence (AI) into STEM education provides opportunities to support inquiry-based and student-centered learning. However, implementing AI-supported learning in remote island schools remains challenging because of limited infrastructure, restricted digital access, and contextual educational barriers. This study examines how AI integrated into Ethno-STEM Project-Based Learning (Ethno-STEM PjBL) supports students' science inquiry skills in remote island schools. A descriptive mixed-method approach was employed involving 63 junior high school students on Lae-Lae Island, Indonesia. Learning activities were conducted through four contextual Ethno-STEM projects related to local food carbon footprints, renewable energy, waste management, and traditional water filtration. AI tools were used to support information exploration, idea generation, project organization, and scientific communication. Quantitative data were collected using a science inquiry skills test covering six dimensions: observing, classifying, hypothesizing, experimenting, using tools and materials, and communicating. Qualitative data were obtained through classroom observations, project documentation, and reflective discussions. Results showed relatively high inquiry skill performance across all dimensions, with observing obtaining the highest score (87%), followed by communicating (79%) and using tools and materials (78%). Qualitative findings indicated that AI-supported inquiry activities encouraged contextual investigation, collaborative exploration, and stronger connections between scientific concepts and local cultural practices. Despite challenges related to internet connectivity and digital literacy, the study suggests that AI-integrated Ethno-STEM PjBL has strong potential to enhance science inquiry skills in geographically isolated educational settings and contributes to discussions on culturally responsive and technology-supported STEM education.

Keywords: Artificial Intelligence, Contextual Learning, Ethno-STEM, Project-Based Learning, Remote Island Schools, Science Inquiry Skills

Introduction

The rapid advancement of digital technology and artificial intelligence (AI) has significantly influenced contemporary educational practices, particularly in science and STEM education (Almasri, 2024; Chng et al., 2023). AI-supported technologies are increasingly being integrated into learning environments to assist students in accessing information, generating ideas, organizing learning tasks, and developing problem-solving strategies (Jufrida et al., 2025). In educational contexts, artificial intelligence is no longer viewed solely as a technological innovation but also as a learning support system capable of facilitating more interactive, student-centered, and inquiry-oriented learning experiences (Karampelas, 2025). The growing use of AI-assisted tools in classrooms has encouraged educators to reconsider how technology can support students' active participation and scientific inquiry processes during learning activities (Küçükuncular, 2025).

In STEM education, science inquiry skills are considered essential competencies that enable students to investigate problems, construct explanations, analyze evidence, and communicate scientific ideas effectively (Ješková et al., 2022). Inquiry skills involve various scientific processes, including observing, classifying, formulating hypotheses, conducting investigations, using tools and materials, and communicating findings. These skills are closely associated with scientific literacy because students are expected not only to understand scientific concepts but also to engage actively in the processes through which scientific knowledge is developed. Previous studies have emphasized that inquiry-oriented learning environments contribute positively to students' critical thinking, problem-solving abilities, and conceptual understanding because students participate directly in authentic scientific investigations (Morris, 2025; Saunders-Stewart et al., 2012).

Despite the increasing emphasis on inquiry-based STEM education, many schools located in remote and geographically isolated areas continue to experience substantial limitations in implementing inquiry-oriented learning practices. Schools in small island communities often face restricted access to digital learning resources, unstable internet connectivity, limited laboratory facilities, and inadequate instructional support (Maisyaroh et al., 2025). Under these conditions, science learning frequently remains teacher-centered and focused on memorization rather than exploration and investigation. As a result, students may have fewer opportunities to develop inquiry skills through meaningful scientific activities connected to real-life contexts.

These challenges indicate the importance of learning approaches that are contextual, culturally relevant, and adaptable to local educational conditions (Ibnu Fitrianto & Muhammad Farisi, 2025). One instructional approach that has attracted considerable attention in STEM education is Project-Based Learning (PjBL) (Beier et al., 2019; Diana et al., 2021). Through project-based learning, students investigate authentic problems, collaborate with peers, and develop solutions through hands-on and inquiry-oriented activities. In remote educational settings, project-based learning may provide opportunities for students to connect scientific concepts with environmental and social issues that are closely related to their daily lives (Sigit et al., 2022).

In recent years, the integration of ethno pedagogical perspectives into STEM education has further expanded the potential of contextual learning approaches. Ethno-STEM education combines scientific knowledge with local wisdom, cultural practices, and

community experiences to create learning environments that are more meaningful and relevant for students. Through Ethno-STEM learning, students are encouraged to reinterpret scientific concepts through local cultural contexts and indigenous knowledge systems (Lee et al., 2023; Sumarni & Kadarwati, 2020). Previous studies have shown that Ethno-STEM Project-Based Learning can support students' conceptual understanding, critical thinking, creativity, and ecological awareness because learning activities are directly connected to contextual problems encountered within students' communities.

The integration of artificial intelligence into Ethno-STEM Project-Based Learning provides additional opportunities for supporting students' inquiry processes during contextual investigations (Jufrida et al., 2025). AI-supported tools may assist students in exploring information, generating project ideas, organizing investigations, interpreting findings, and developing digital learning products (Kim et al., 2025). Rather than replacing the role of teachers, artificial intelligence may function as cognitive scaffolding that supports students during scientific inquiry activities. In culturally responsive STEM learning environments, AI-assisted exploration may also help students connect local wisdom with broader scientific knowledge and digital resources (Okada et al., 2025).

However, most previous studies concerning artificial intelligence in education have focused primarily on technologically advanced or urban educational settings. Research examining how AI integration supports science inquiry skills within culturally responsive and context-based STEM learning environments remains limited, particularly in remote island schools. In addition, previous studies related to Ethno-STEM Project-Based Learning have predominantly emphasized ecological awareness, learning experiences, and conceptual understanding, while relatively fewer studies have investigated how AI-supported learning environments facilitate the development of students' science inquiry skills during project activities.

Therefore, this study investigates the integration of artificial intelligence into Ethno-STEM Project-Based Learning and explores how this learning approach supports students' science inquiry skills in remote island schools. The study focuses on students' inquiry processes during contextual projects involving local environmental and cultural issues, including food consumption, renewable energy, waste management, and water conservation. By examining students' inquiry activities within AI-supported contextual learning environments, this study seeks to contribute to the growing discussion regarding the role of artificial intelligence in culturally responsive STEM education and remote educational contexts.

Review of Related Literature

The integration of project-based learning (PjBL) and artificial intelligence (AI) into STEM education has been widely studied for its impact on student engagement, inquiry skills, and academic achievement. Al-Bahadli et al. (2023) demonstrated that online PjBL enhances communication, motivation, and performance, while Beier et al. (2019) and Diana et al. (2021) confirmed its effectiveness in shaping STEM attitudes and career aspirations. Dias-Oliveira et al. (2024) extended these findings to business education, showing improvements in critical thinking and teamwork.

AI-supported learning environments have emerged as transformative tools in science education. Almasri (2024) and Chng et al. (2023) highlighted AI's role in facilitating inquiry-based learning, while Karampelas (2025) and Kunnath & Botes (2025)

emphasized its potential to nurture critical thinking and scientific inquiry. Studies such as Jin et al. (2023) and Gligorea et al. (2023) explored AI's contribution to self-regulated and adaptive learning, whereas Derakhshan & Taghizadeh (2025) examined its influence on higher-order thinking skills.

Culturally responsive approaches further enrich STEM pedagogy. Brown (2017) and Ibnu Fitrianto & Farisi (2025) stressed the importance of integrating local wisdom and equity-focused practices. Ethno-STEM models, as discussed by Sumarni & Kadarwati (2020) and Jufrida et al. (2025), demonstrated how contextual learning fosters creativity, ecological awareness, and cultural relevance.

Collectively, these studies reveal a convergence of AI-supported inquiry, project-based learning, and culturally responsive pedagogy. Together, they underscore the potential of integrating AI-driven tools with contextual PjBL to enhance inquiry skills, critical thinking, and meaningful engagement in STEM education, particularly in diverse and resource-limited settings.

Objective

The purpose of this research is to explore how artificial intelligence can be integrated into Ethno-STEM Project-Based Learning to enhance students' science inquiry skills in remote island schools. It focuses on contextual projects linked to local cultural and environmental issues—such as food consumption, renewable energy, waste management, and water conservation—while examining how AI-assisted tools support observation, investigation, interpretation, and communication. By aligning inquiry processes with culturally responsive pedagogy, the study seeks to advance both STEM education and AI-supported learning in resource-limited contexts.

Methodology

Research Design

This study employed a descriptive mixed-method approach to explore how the integration of artificial intelligence into Ethno-STEM Project-Based Learning (Ethno-STEM PjBL) supported students' science inquiry skills in a remote island school context (Kunnath & Botes, 2025). The study focused on examining students' inquiry processes during contextual project activities and identifying how AI-supported learning tools facilitated scientific investigation, exploration, and communication throughout the learning process. A mixed-method approach was selected to obtain a more comprehensive understanding of students' science inquiry skills within AI-supported contextual learning environments. Quantitative data were used to describe students' science inquiry skill performance across several inquiry dimensions, while qualitative data were utilized to examine students' inquiry experiences, collaborative investigation processes, and interactions during project activities. The integration of quantitative and qualitative findings enabled a deeper interpretation of how AI-supported Ethno-STEM learning functioned in geographically isolated educational settings.

Research Site and Participants

The research was conducted at a junior high school located on Lae-Lae Island, Makassar, Indonesia. Lae-Lae Island is part of the Spermonde Archipelago and represents a small island area with limited educational infrastructure and constrained access to digital learning resources. Most community members work in fisheries and small-scale

economic sectors, while educational facilities and technological access remain relatively limited compared to urban schools.

The participants consisted of 63 junior high school students from Grades 7, 8, and 9 who participated in the Ethno-STEM Project-Based Learning activities. The participants were selected purposively based on their involvement in the learning program and project activities implemented during the study. All students participated in contextual project investigations designed to connect scientific inquiry with local environmental and cultural issues found in island communities.

Learning Intervention

The learning intervention was implemented through Ethno-STEM Project-Based Learning integrated with AI-supported inquiry activities. The learning program was designed to encourage students to investigate contextual environmental problems while integrating scientific concepts, local wisdom, and collaborative problem-solving activities.

Four contextual projects were implemented during the learning activities: (1) local food carbon footprint investigation, (2) mini solar photovoltaic system development, (3) bio-conversion-based waste bank project, and (4) traditional water filtration technology. These projects were selected because they reflected ecological and sociocultural issues closely related to students' daily experiences in island communities.

Artificial intelligence tools were integrated into several stages of project activities to support inquiry processes. Students utilized AI-assisted digital platforms to explore information related to environmental problems, generate project ideas, organize investigation procedures, interpret findings, and develop digital learning products. During project implementation, AI-supported tools also assisted students in comparing information sources, generating alternative solutions, and preparing project presentations. Teachers functioned as facilitators who guided students during inquiry activities, collaborative discussions, experimentation, and reflection sessions. The role of artificial intelligence in this study was positioned as cognitive support for inquiry-oriented learning rather than as a replacement for teacher instruction.

Instruments

Data collection was conducted using quantitative and qualitative instruments. Quantitative data were obtained using a science inquiry skills test developed based on several dimensions of scientific inquiry processes. The instrument consisted of 30 multiple-choice items distributed across six inquiry skill indicators: observing, classifying, formulating hypotheses, conducting experiments, using tools and materials, and communicating findings.

The inquiry skill instrument was contextualized according to the Ethno-STEM projects implemented during learning activities. Several test items were developed based on local environmental issues, including food consumption patterns, renewable energy utilization, waste management practices, and traditional water filtration systems in island communities. The instrument was designed to measure students' ability to apply scientific inquiry processes within contextual problem-solving situations.

Qualitative data were collected through classroom observations, students' project documentation, reflective discussions, and field notes recorded during project implementation. Observations focused on students' inquiry behaviors, collaborative interactions, problem-solving activities, and the use of AI-supported tools during learning activities. Documentation included students' project reports, digital learning products, photographs of project activities, and presentation materials.

Analysis

Quantitative data obtained from the science inquiry skills test were analyzed descriptively using mean scores, percentages, and category classifications for each inquiry skill dimension. The analysis was conducted to identify patterns of students' inquiry performance across the six indicators of science inquiry skills.

Qualitative data from classroom observations, reflective discussions, and project documentation were analyzed using thematic analysis. The analysis involved data reduction, coding, categorization, and interpretation to identify recurring themes related to AI-supported inquiry activities, contextual investigation, collaborative learning, and students' engagement in scientific exploration. The integration of quantitative and qualitative findings was conducted to provide a comprehensive understanding of how artificial intelligence supported science inquiry skills development within Ethno-STEM Project-Based Learning in remote island schools.

Findings and Discussion

Students' Science Inquiry Skills in AI-Integrated Ethno-STEM Project-Based Learning

The implementation of Artificial Intelligence-integrated Ethno-STEM Project-Based Learning (AI-integrated Ethno-STEM PjBL) demonstrated positive patterns in students' science inquiry skills during contextual project activities conducted in the remote island school setting. Throughout the learning process, students were actively involved in various inquiry-oriented activities, including observing environmental phenomena, classifying information and materials, formulating hypotheses, conducting simple investigations, utilizing scientific tools and materials, and communicating project findings collaboratively.

The quantitative analysis of students' science inquiry skills revealed that all inquiry dimensions achieved relatively high scores. Figure 1 presents the percentage scores of students' inquiry skills across six indicators, namely observing, classifying, hypothesizing, experimenting, using tools and materials, and communicating.

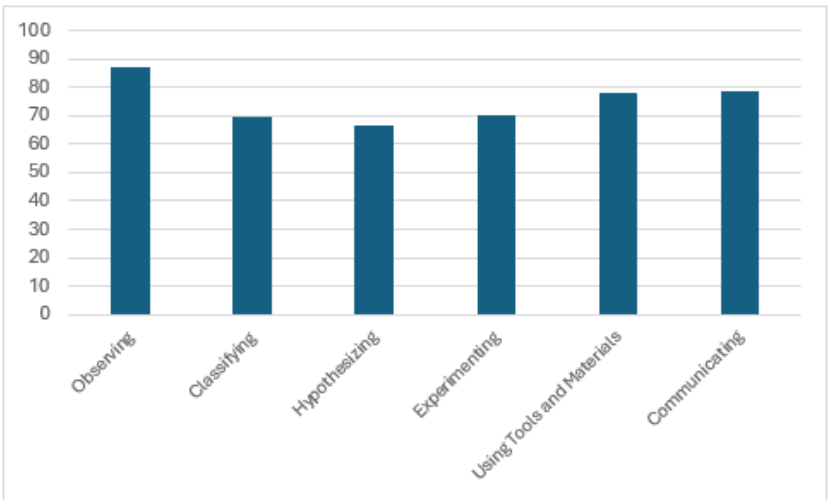

Figure 1. Students' Science Inquiry Skills in AI-Integrated Ethno-STEM Project-Based Learning

The findings indicate that the observing skill obtained the highest score (87%), followed by communicating (79%) and using tools and materials (78%). Meanwhile, classifying and experimenting each achieved a score of 70%, while hypothesizing obtained the lowest score among all indicators (67%). Although variations existed across inquiry dimensions, the results generally suggest that students demonstrated relatively strong engagement in scientific inquiry activities during project implementation.

The high score in observing skills indicates that students were able to identify and examine contextual environmental phenomena encountered in their surrounding communities. During project activities, students conducted direct observations related to local food consumption patterns, waste management practices, water conditions, and renewable energy utilization in island environments. The integration of AI-supported digital tools appeared to assist students in accessing additional information and comparing their field observations with broader scientific explanations obtained through digital exploration.

Students also demonstrated relatively strong performance in communication skills. During project implementation, students were required to present findings, discuss investigation results, and explain project solutions collaboratively. Several student groups utilized AI-assisted digital applications to prepare project presentations, organize investigation reports, and develop visual learning products such as posters and presentation slides. These activities encouraged students to communicate scientific information more systematically and confidently during collaborative learning sessions.

The using tools and materials dimension also showed relatively high achievement. Students were actively involved in utilizing scientific tools and locally available materials during project activities, particularly in the mini solar photovoltaic system project, waste management activities, and traditional water filtration experiments. Students demonstrated the ability to operate simple experimental tools, organize project materials, and conduct practical investigations related to local environmental issues. The contextual nature of the projects enabled students to connect scientific inquiry processes with everyday experiences within their island communities.

Meanwhile, the classifying and experimenting dimensions achieved moderate-to-high scores. Students were generally able to categorize information, distinguish types of waste materials, identify environmentally friendly resources, and organize investigation findings during project activities. In the experimenting dimension, students participated actively in designing simple procedures, testing project products, and evaluating investigation outcomes. However, several students still experienced difficulties in conducting systematic investigations independently and interpreting experimental results critically without teacher guidance.

Among all inquiry dimensions, hypothesizing obtained the lowest score. This finding suggests that students experienced greater challenges when formulating predictions and constructing scientific explanations before conducting investigations. During several project activities, students were more accustomed to observing and discussing directly observable phenomena rather than developing predictive reasoning based on scientific concepts. Although AI-supported tools assisted students in generating ideas and exploring possible explanations, some students still required scaffolding from teachers to formulate logical and evidence-based hypotheses.

Qualitative observations further revealed that the integration of AI into Ethno-STEM Project-Based Learning supported students' inquiry activities in several ways. AI-assisted tools helped students search for contextual information related to local ecological issues, compare alternative project ideas, and access broader scientific explanations connected to local cultural practices. Students frequently utilized AI-supported platforms during brainstorming sessions, investigation planning, and project reporting activities. These interactions encouraged collaborative exploration and strengthened students' engagement in contextual scientific inquiry.

In addition, the contextual and culturally responsive nature of Ethno-STEM projects appeared to increase students' participation during inquiry activities. Students showed greater interest when scientific investigations were directly related to familiar environmental problems and local community practices. Projects involving local food consumption, renewable energy, waste management, and traditional water filtration enabled students to connect scientific concepts with their lived experiences in island environments. This contextual connection appeared to facilitate more meaningful inquiry processes during learning activities.

Despite the positive findings, several challenges were also identified during project implementation. Limited internet connectivity occasionally disrupted AI-assisted information exploration activities, and some students experienced difficulties evaluating the reliability of AI-generated information. In addition, differences in students' prior digital literacy skills influenced their ability to utilize AI-supported tools effectively during inquiry activities. Nevertheless, collaborative learning and teacher facilitation helped students adapt to the use of AI-assisted technologies throughout the learning process.

Overall, the findings suggest that integrating artificial intelligence into Ethno-STEM Project-Based Learning may provide meaningful opportunities for supporting students' science inquiry skills in remote island schools. The combination of contextual project activities, local wisdom integration, collaborative investigation, and AI-assisted

exploration created learning experiences that encouraged students to participate actively in scientific inquiry processes despite existing technological limitations.

The findings of this study indicate that the integration of artificial intelligence into Ethno-STEM Project-Based Learning (Ethno-STEM PjBL) supported students' science inquiry skills in the context of remote island schools. Overall, students demonstrated relatively strong performance across all inquiry dimensions, particularly in observing, communicating, and using tools and materials. These findings suggest that contextual and culturally responsive project activities integrated with AI-supported learning tools may create meaningful opportunities for students to engage in scientific inquiry processes despite limitations in educational infrastructure and technological access.

One of the most notable findings of this study is the high achievement in observing skills. Students were able to identify environmental phenomena, recognize contextual problems, and gather relevant information during project activities related to local food systems, waste management, renewable energy, and water conservation. The strong performance in observing skills may be closely related to the contextual nature of Ethno-STEM learning, where students investigated problems directly connected to their everyday experiences in island communities. Because students interacted with real environmental situations familiar to their social and cultural context, inquiry activities became more meaningful and easier to relate to daily life.

The integration of AI-supported tools also appeared to strengthen students' observation processes. During project implementation, students used digital platforms to search for additional explanations, compare local findings with scientific information, and explore environmental issues beyond their immediate surroundings. AI-assisted information exploration provided students with broader access to knowledge sources that may otherwise be difficult to obtain in geographically isolated schools. This finding supports the view that artificial intelligence can function as a cognitive scaffolding tool that assists students during inquiry-oriented learning activities by supporting information access, idea generation, and exploratory investigation.

Communication skills also showed relatively high achievement during project activities. Students were actively involved in presenting project findings, discussing investigation results, and developing collaborative explanations related to environmental problems encountered during learning. The project-based structure of learning encouraged students to communicate ideas more frequently through group discussions, presentations, and digital artefact creation (Al-Bahadli et al., 2023; Dias-Oliveira et al., 2024; Owens & Hite, 2022). Several groups utilized AI-assisted tools to organize project reports, prepare presentation materials, and create visual learning products, which appeared to enhance students' confidence and participation during scientific communication activities.

The improvement in communication skills may also be influenced by the collaborative nature of Ethno-STEM PjBL. Students were required to exchange ideas, negotiate solutions, and explain project outcomes to peers and teachers throughout the learning process. Such collaborative interactions are important components of inquiry-oriented STEM learning because scientific understanding is often developed through social discussion and reflective communication (Bell et al., 2010; Gillies, 2023). In addition, contextual projects grounded in local environmental issues may have encouraged students

to communicate more confidently because the investigated problems were closely related to their lived experiences and community realities (Klein et al., 2021; Vare, 2021).

Another important finding is the relatively high achievement in using tools and materials. Students demonstrated the ability to utilize scientific equipment and locally available materials during contextual investigations, particularly in projects involving solar energy systems, waste management, and traditional water filtration. This finding indicates that hands-on project activities remain essential for supporting inquiry skills development, even in schools with limited laboratory infrastructure. Through contextual projects, students were not only exposed to theoretical explanations but also engaged directly in practical investigation processes that required active manipulation of tools, materials, and environmental resources (Besner & Hobbs, 2013).

Although students generally performed well across inquiry dimensions, hypothesizing showed the lowest score among all indicators. This finding suggests that constructing predictive reasoning and formulating scientific explanations remained relatively challenging for students. During several project activities, students tended to rely more on direct observation and procedural investigation than on abstract reasoning and predictive thinking. This pattern may be influenced by students' previous learning experiences, which in many remote educational contexts are still dominated by teacher-centered instruction and factual memorization rather than inquiry-oriented reasoning activities (Gligorea et al., 2023; Jin et al., 2023).

The relatively lower performance in hypothesizing also indicates that inquiry learning requires continuous scaffolding and sustained exposure to scientific reasoning practices. While AI-supported tools assisted students in generating ideas and exploring alternative explanations, students still required guidance in constructing evidence-based predictions and connecting observations with underlying scientific concepts. This finding suggests that artificial intelligence alone may not automatically strengthen higher-order inquiry processes unless accompanied by structured facilitation and reflective discussion led by teachers (Derakhshan & Taghizadeh, 2025).

The findings further demonstrate the important role of contextual and culturally responsive learning environments in supporting inquiry-oriented STEM education (Brown, 2017). Through Ethno-STEM PjBL, scientific concepts were connected with local wisdom, environmental practices, and community experiences familiar to students. Projects involving food consumption patterns, renewable energy, waste management, and water conservation enabled students to investigate scientific problems situated within their own ecological and sociocultural environment. This contextual connection likely increased students' motivation and participation during inquiry activities because learning tasks were perceived as relevant and meaningful.

An important contribution of this study lies in demonstrating that artificial intelligence integration does not necessarily diminish the role of local wisdom and contextual learning. Instead, AI-supported learning tools functioned as complementary resources that helped students expand their exploration of local environmental problems through broader scientific perspectives and digital information access. Students were able to connect traditional knowledge and local practices with scientific explanations obtained through AI-assisted inquiry activities. This finding highlights the potential of combining

culturally responsive STEM learning with digital technologies in ways that preserve local identity while simultaneously supporting scientific exploration and technological literacy. The implementation of AI-integrated Ethno-STEM PjBL also revealed several practical challenges. Limited internet connectivity occasionally restricted students' ability to access digital resources consistently during project activities. Some students also experienced difficulties in evaluating the credibility and accuracy of AI-generated information. These findings indicate that effective AI integration in remote educational contexts requires adequate teacher facilitation and the development of students' critical digital literacy skills. Without appropriate guidance, students may encounter difficulties distinguishing reliable scientific information from inaccurate or oversimplified AI-generated responses (Sirnoorkar et al., 2024; Zhai et al., 2024).

Despite these limitations, the findings suggest that integrating artificial intelligence into contextual and culturally responsive project-based learning may provide promising opportunities for supporting science inquiry skills in geographically isolated schools. The combination of AI-assisted exploration, collaborative project activities, and local environmental investigation enabled students to participate more actively in inquiry-oriented learning processes. This study contributes to the growing discussion regarding artificial intelligence in education by highlighting the importance of contextual adaptation, cultural relevance, and inquiry-based pedagogy in the implementation of AI-supported STEM learning environments.

Limitations and Future Research

Several limitations should be considered when interpreting the findings of this study. First, the research was conducted in a single remote island school with a relatively limited number of participants. Although the study provides important insights into the implementation of AI-integrated Ethno-STEM Project-Based Learning in geographically isolated educational settings, the findings may not fully represent the conditions of other remote schools with different sociocultural and technological characteristics. Educational environments in island communities can vary substantially in terms of infrastructure, digital access, teacher readiness, and local cultural practices, which may influence the implementation of inquiry-oriented STEM learning.

Second, the study primarily focused on students' science inquiry skills during the implementation of contextual project activities and did not examine long-term changes in students' scientific reasoning, digital literacy, or academic achievement. The data were collected during a relatively limited intervention period, making it difficult to identify whether the observed inquiry skills could be sustained over longer learning durations. In addition, this study relied mainly on descriptive analysis and did not compare the learning outcomes with those of students experiencing conventional instructional approaches.

Another limitation concerns the integration of artificial intelligence within the learning process. In this study, AI-supported tools functioned primarily as learning support systems for information exploration, idea generation, and project development rather than as adaptive or fully personalized AI learning environments. Differences in students' digital literacy levels and familiarity with AI-assisted technologies also influenced the extent to which students utilized digital tools during inquiry activities. Furthermore, limited internet connectivity occasionally disrupted AI-supported exploration processes, which remains a significant challenge in remote educational contexts.

Future studies may expand this research by involving multiple schools from different island or rural regions to obtain broader insights into the implementation of AI-supported Ethno-STEM learning in diverse educational contexts. Longitudinal studies are also needed to examine the long-term influence of AI-integrated project-based learning on students' inquiry skills, scientific reasoning, and sustainability-oriented behaviours. In addition, future research may investigate how different forms of artificial intelligence, such as adaptive learning systems or generative AI platforms, influence students' collaborative inquiry, creativity, and problem-solving processes during STEM learning activities.

Further investigations could also explore teachers' readiness, ethical considerations, and digital equity issues related to AI integration in culturally responsive STEM education. Since AI technologies continue to develop rapidly, future studies should examine how local wisdom and indigenous knowledge can be meaningfully preserved and integrated within increasingly digitalized learning environments. Such investigations are important to ensure that technology-enhanced STEM education remains contextually relevant, culturally sensitive, and accessible for students in resource-limited educational settings.

Conclusion

This study explored the integration of artificial intelligence into Ethno-STEM Project-Based Learning and examined its role in supporting students' science inquiry skills in a remote island school context. The findings indicate that AI-integrated Ethno-STEM PjBL created meaningful opportunities for students to engage in contextual scientific inquiry activities connected to local environmental and cultural issues. Students demonstrated relatively strong performance across several inquiry dimensions, particularly in observing, communicating, and using tools and materials during project implementation. The results suggest that contextual projects grounded in local wisdom and environmental realities encouraged students to participate more actively in inquiry-oriented learning processes. Through investigations related to food consumption, renewable energy, waste management, and traditional water filtration, students were able to connect scientific concepts with their daily experiences in island communities. The integration of artificial intelligence further supported these inquiry processes by assisting students in information exploration, idea generation, project organization, and scientific communication activities.

Although hypothesizing remained the most challenging inquiry dimension, the overall findings demonstrate that AI-supported learning environments may contribute positively to the development of science inquiry skills when integrated within collaborative and culturally responsive project-based learning activities. The study also highlights that artificial intelligence does not necessarily replace local wisdom or teacher facilitation; instead, AI can function as a supportive learning resource that expands students' opportunities for contextual investigation and scientific exploration.

Overall, this study contributes to the growing discussion regarding artificial intelligence in STEM education by demonstrating the potential of AI-integrated Ethno-STEM Project-Based Learning in geographically isolated schools with limited educational resources. The combination of contextual inquiry, local wisdom integration, collaborative investigation, and AI-assisted exploration offers a promising approach for supporting meaningful and inquiry-oriented STEM learning experiences in remote educational environments.

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Artificial Intelligence: A Bridge that Connects Disjoint Sets, Approaches Infinity and Converges to Innovation

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Abstract

Mathematics is widely regarded as the foundation of all sciences and as a universal language that explains the structure of the world around us. From medieval mathematics to modern computational theory, concepts such as Boolean Algebra have evolved into essential components of Artificial Intelligence (AI). Today, AI not only assists in solving mathematical problems but also transforms the way mathematical ideas are visualized and understood. Memorizing sine values, for example, is very different from observing AI-generated sine wave visualizations that deepen conceptual understanding and curiosity. Modern AI platforms such as Wolfram Alpha, Symbolab, Photo math and AI4Math are reshaping mathematics education by providing intelligent solutions, visual interpretations and step-by-step reasoning. AI techniques also support the verification of human-generated proofs and contribute to advanced mathematical research. The ancient Chinese text I Ching, known for its symbolic hexagrams and decision-making guidance, has inspired AI-driven digital interpretations that combine symbolic reasoning with intelligent analysis. The emergence of AI4Math marks a new interdisciplinary field where machine learning intersects with mathematical reasoning. Beyond education, AI contributes to black hole theory, geometry, differential equations, and cosmological simulations through advanced data analysis and 3D visualization. The integration of Mathematics, Artificial Intelligence, and General Relativity continues to reshape our understanding of time, space, and the universe, highlighting the transformative potential of AI in mathematics, scientific discovery, and future innovation. Although time travel remains theoretical, these disciplines enable scientists to reconstruct, simulate, and interpret events with remarkable precision, opening possibilities for understanding cosmic phenomena and advancing modern physics through computational models.

Keywords: AI4Math and Cosmic Phenomena, I Ching, General Relativity

Introduction

Mathematics is humanity's first language. It transformed abstract thoughts into petroglyphs and petrographs (in forms of straight line), giving ideas their first written, permanent form. The evolution of mathematics began with ancient Egyptian mathematics, developed through Babylonian mathematics, and was further advanced by Chinese, Greek, Indian, and Medieval mathematics. It then grew through European mathematics into the 21st century (Boyer & Merzbach, 2011). Mathematics has grown vastly. From this evidence, it is evident that the advancement of our species is inextricably linked to our understanding of mathematics. For the fruits of improvement, we must water the garden of mathematics.

However, the learning process and the iteration is highly complex so to unite fractals we can use Artificial Intelligence.

Review of Related Literature

Ancient Egyptian mathematics gave rise to a sophisticated understanding of arithmetic, algebra, and geometry. These ideas made it possible to solve second- and third-order equations and to calculate the volume of objects like pyramids and cylinders. The Egyptians also developed the first accurate calendar with a 365-day cycle. The Babylonians advanced mathematics through astronomy. They tracked the sun, moon, and planets using a base-60 number system, which gave us 60 seconds in a minute and 60 minutes in an hour. They also solved polygonal areas, computed square and cube roots, estimated π, and used fractions.

Chinese mathematics made significant advances in geometry, algebra and trigonometry (Wilhelm, 1967). They calculated the value of π to five decimal places and invented the abacus, a counting frame used for calculation since ancient times. They developed I Ching, a system used for divination and astrological calculations, divination being the practice of seeking knowledge of the future or the unknown by supernatural means. The concept of negative numbers was first formalized by the Chinese mathematician Yang Hui in the 13th century (Euclid, 2008). The yin-yang symbol also reflects their early grasp of duality, a concept fundamental to mathematics and logic.

Greek mathematics introduced many fundamental concepts and theorems, including the Pythagorean Theorem, Euclid's Elements and the concept of formal proof. Euclid, known as the "father of geometry," authored Elements, a foundational work in mathematics. The Project Gutenberg archive (https://www.gutenberg.org) provides detailed access to his work. Apollonius of Perga (c. 262 BCE) is renowned for his work on conic sections, ellipses, parabolas and hyperbolas and for generalizing the Pythagorean Theorem.

Archimedes of Syracuse (c. 287–212 BCE) made ground-breaking contributions to Mathematics, Physics and Engineering. He is best known for the Archimedes Principle, the law of the lever and his work on areas and volumes. Pythagoras (c. 570–495 BCE) is credited with the Pythagorean Theorem, which states: "In a right-angled triangle, the square of the hypotenuse is equal to the sum of the squares of the other two sides." The sides are known as the perpendicular, base, and hypotenuse. Indian mathematics dates back to the Vedic period and made foundational contributions to algebra and trigonometry. Aryabhata formulated sine and cosine rules and made important contributions to number theory and algebra, including methods for solving cubic equations and calculating the area of a triangle (Aryabhata, 1973; Brahmagupta, 1880).

Indian mathematicians also developed the concept of zero and the decimal system. Bhaskara advanced logic through the concept of proof by contradiction. Brahmagupta made significant contributions to number theory and algebra through his writings, including rules for operating with zero and negative numbers. Centuries before Newton and Leibniz, mathematicians like Madhava of Sangamagrama and Nilakantha Somayaji initiated the development of calculus, including infinite series expansions for trigonometric functions. In computational geometry, Mahavira developed a theorem for cyclic quadrilaterals, stating that the area equals the sum of the areas of triangles formed on each side.

Islamic mathematics advanced algebra and number systems using Euclidean geometry (AI-Khwarizmi, 1831). Sharaf al-Din al-Tusi developed methods for solving cubic equations.

Al-Khwarizmi introduced reduction techniques for linear and quadratic equations, giving algebra its name. Islamic scholars also influenced logic systems that later shaped Boolean algebra, now essential to computer science and AI. Renaissance mathematicians revolutionized the field. Viete created symbolic algebra and methods for solving equations, paving the way for calculus (Euler, 1748). Descartes developed the Cartesian plane, linking algebra and geometry. De Beaune and Pascal established probability theory and Pascal also built one of the first mechanical calculators (Hilbert, 1902; Noether, 1971). The 17th and 18th centuries saw major advances in calculus, analysis and abstract algebra. Leonhard Euler, a Swiss mathematician, made profound contributions to calculus, number theory, graph theory and astronomy. He introduced much of modern mathematical notation and solved problems with remarkable rigor. Euler also wrote influential works on the calculus of variations and established foundational results in graph theory.

Joseph-Louis Lagrange, an Italian-French mathematician, advanced calculus and mechanics. He developed the method of Lagrange multipliers, contributed to the calculus of variations and made key advances in differential equations and number theory. The late 18th and early 19th centuries also saw the emergence of abstract algebra. Mathematicians such as Augustin-Louis Cauchy and Évariste Galois developed group theory and other algebraic structures to solve equations of an abstract nature. Abstract algebra would become one of mathematics' most influential fields, with applications across science.

The 19th century was a period of rigor and abstraction that reshaped mathematics. Georg Cantor, a German mathematician, founded set theory and formalized the concept of different sizes of infinity, now central to modern mathematics. Karl Weierstrass and Sofia Kovalevskaya advanced mathematical analysis. Weierstrass established rigorous foundations for calculus through his precise definition of limits and functions, while Kovalevskaya made pioneering contributions to partial differential equations and mechanics. The century transformed set theory, analysis and algebra, setting the stage for modern mathematics. The 20th century became an ever-expanding field, driven by advances in computer technology that enabled computers, the internet, and digital communication (Turing, 1934). Algebra progressed significantly through the work of David Hilbert and Emmy Noether, who developed the abstract theory of groups, rings, and fields. Real analysis and differential equations advanced through many contributors. While Carl Gauss and Isaac Newton worked in earlier centuries, 20th-century figures like Stephen Hawking applied these tools to cosmology and physics.

Objectives

Modern mathematics continues to expand, with fields like graph theory and network analysis gaining prominence. Mathematicians now apply algorithms and data mining techniques to develop practical solutions for real-world problems. To illustrate recent advances, consider the computation of π. The current record stands at over 31.4 trillion digits thousands of times greater than the number calculated by the Chudnovsky brothers on their home-built supercomputer. Emma Haruka Iwao, a Google employee, who performed the calculation over 121 days using the freely available program y-cruncher, set the record. The result was verified with an additional 48 hours of computation. The calculation required storage comparable to the entire digital collection of the Library of Congress.

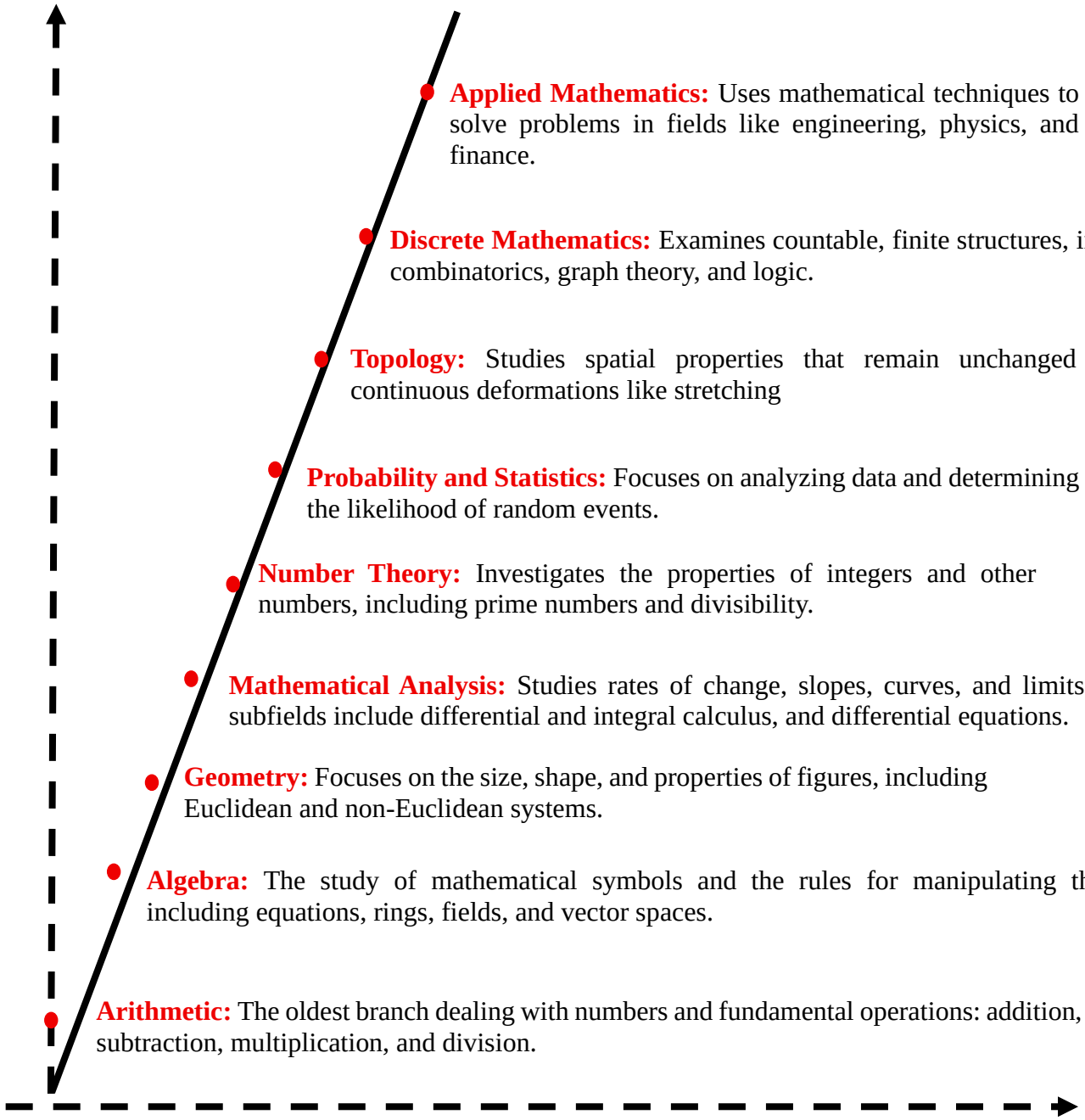
Iwao has been computing π since childhood. Her achievement increased humanity's known digits of π by roughly 40%. The previous record, over 22 trillion digits, was computed in

105 days on a Dell server, also using y-cruncher. This program employs both the Ramanujan and Chudnovsky formulas and has been used to calculate record-length expansions of other irrational numbers, including e, log 2, and the golden ratio.

The twenty-first century marks the first era in which earlier mathematical ideologies have been consolidated and applied to artificial intelligence to drive the future of mathematics.

Methodology

The Spectrum of Mathematics:



In

Arithmetic: AI-based tools can explain calculations step by step, correct mistakes instantly, and use interactive methods such as quizzes, games, and virtual tutors to make mathematical concepts easier, faster, and more engaging for students to learn.

Algebra: AI-powered virtual reality classrooms can visually demonstrate algebraic concepts such as graphs, functions, and equations in a real-time interactive environment. Advanced AI assistants can predict areas where students may struggle in algebra and provide preventive guidance, personalized study plans, and real-world problem-solving applications.

Geometry: Artificial Intelligence enhances the learning of Geometry by helping students visualize shapes, angles, and spatial relationships through interactive 3D models and simulations. AI-based tools can provide step-by-step explanations for geometric constructions and theorems, identify errors in diagrams and calculations, and create personalized exercises to improve understanding of Euclidean and non-Euclidean geometry concepts.

Mathematical Analysis: Artificial Intelligence enhances the learning of Mathematical Analysis by helping students understand concepts such as limits, slopes, curves, and rates of change through interactive graphs and visual simulations. AI-powered tools can solve differential and integral calculus problems step by step, explain complex equations clearly, and provide personalized practice and instant feedback to improve understanding of calculus and differential equations.

Number Theory: Artificial Intelligence enhances the learning of Number Theory by helping students understand the properties of integers, prime numbers, divisibility, and mathematical equations through step-by-step explanations and logical analysis. AI-based tools can identify number patterns, solve complex numerical problems, generate personalized practice exercises, and use interactive methods to improve understanding of concepts related to factors, multiples, and number relationships.

Probability and Statistics: Artificial Intelligence enhances the learning of Probability and Statistics by helping students analyze data, identify patterns, and understand the chances of random events through interactive graphs and simulations. AI-powered tools can solve statistical and probability problems step by step, provide instant feedback, generate personalized practice questions, and use real-world data analysis to improve understanding of concepts such as distributions, averages, and probability calculations.

Topology: Artificial Intelligence enhances the learning of Topology by helping students visualize spatial properties and continuous transformations such as stretching, bending, and twisting through interactive 3D simulations. AI-based tools can explain topological concepts step by step, analyze shapes and structures, and provide personalized exercises and visual models to make abstract topology concepts easier to understand and apply.

Discrete Mathematics: Artificial Intelligence enhances the learning of Discrete Mathematics by helping students understand finite and countable structures through interactive problem-solving and logical analysis. AI-powered tools can explain concepts such as combinatorics, graph theory, and logic step by step, generate personalized practice

questions, and use visual models and simulations to make complex discrete mathematical concepts easier and more engaging to learn.

Applied Mathematics: Artificial Intelligence enhances the learning of Applied Mathematics by helping students apply mathematical methods to real-world problems in engineering, physics, finance, and technology. AI-based tools can analyze complex data, simulate practical situations, solve mathematical models step by step, and provide interactive visualizations to improve understanding of formulas, calculations, and problem-solving techniques used in applied fields.

Analysis

Some of the tools to learn the above are:

Arithmetic

1. Photomath – Solves arithmetic problems with step-by-step explanations.
2. Prodigy Math – Uses AI-based games to improve basic calculations and problem-solving skills.
3. Khan Academy – Provides personalized arithmetic practice and instant feedback.

Algebra

1. Microsoft Math Solver – Explains algebraic equations step by step.
2. Wolfram Alpha – Solves algebra problems and simplifies expressions.
3. Symbolab – Provides detailed algebra solutions and graph visualizations.

Geometry

1. GeoGebra – Visualizes geometric shapes, angles, and constructions interactively.
2. Geometry Pad – Helps students draw and explore geometric figures.
3. Cabri Geometry – Uses dynamic models to explain geometric concepts.

Mathematical Analysis

1. MATLAB – Helps analyze functions, curves, and calculus problems.
2. Maple – Solves differential and integral equations step by step.
3. Desmos – Visualizes limits, slopes, and graphs interactively.

Number Theory

1. SageMath – Explores prime numbers and divisibility concepts.
2. PARI/GP – Performs advanced number theory calculations.
3. Mathematica – analyses numerical patterns and equations.

Probability and Statistics

1. IBM SPSS Statistics – Analyses data and probability distributions.
2. RStudio – Performs statistical modelling and data visualization.
3. Tableau – Uses AI-driven charts and graphs for statistical analysis.

Topology

1. Mathematica – Visualizes topological transformations and structures.
2. MATLAB – Simulates continuous deformations and spatial models.
3. Blender – Helps visualize complex topological surfaces in 3D.

Discrete Mathematics

1. Graphviz – Visualizes graph theory concepts and networks.
2. SageMath – Solves combinatorics and logic problems.
3. Prolog – Helps understand logical reasoning and discrete structures.

Applied Mathematics

1. MATLAB – Solves engineering and scientific mathematical problems.
2. Simulink – Simulates real-world systems and mathematical models.
3. COMSOL Multiphysics – Applies mathematics to physics and engineering

Findings and Discussion

Avenues for Future Investigation

I Ching – Theory:

The I Ching or Book of Changes is a text in Chinese philosophy. It says that change is always happening. Life is not static and being wise means understanding and going with that flow. At its core are 64 hexagrams. These are symbols made of unbroken lines. Each one represents a situation, energy or phase of change. Traditionally people use them to think about decisions, relationships, personal growth and what next. The I Ching is based on Yin and Yang. These are two forces, like light and dark action and stillness, strength and receptivity. Over time the I Ching has influenced thought, ethics and culture.

Here are some ways people use the I Ching:

1. Decision Making – It helps when making personal, professional or relationship choices.
2. Self-Understanding – It gives a way to look at your motives, emotions and behavior to grow.
3. Spirituality – It teaches balance, patience and accepting that things change.
4. Business and Leadership – Leaders use its ideas for strategy, risk and uncertainty.
5. Psychology – The symbols help with self-analysis and therapy.
6. Art and Creativity – Its images and themes inspire writers, artists and musicians.
7. Technology and Computing – The hexagram structure is like binary code, which computers use.

Benefits of the I Ching Theory:

1. It helps see change, as normal making it easier to handle transitions and encourages decision-making.
2. It supports harmony by emphasizing balance and increases self-awareness and emotional intelligence.
3. It can be used in areas, like philosophy, psychology, business and art.
4. It sparks creativity. Helps solve problems and gives a direction when things are uncertain.

Cosmic phenomena:

Cosmic phenomena are events and processes that happen outside Earth. They include things like stars being born and dying and how galaxies, black holes and dark matter behave. These things are controlled by physics rules like General Relativity and quantum mechanics. They help shape the universe, as we know it. By studying phenomena, we can learn where we come from what rules the universe follows and what might happen next.

Applications of Studying Cosmic Phenomena

1. Astrophysics & Cosmology – We can test ideas about gravity, space and time. How the universe began.
2. Technology Development – Looking at pulsars, gravitational waves and black holes helps us make sensors, computers and measuring tools.
3. Navigation & Timekeeping – GPS and global timing systems need corrections that we found out by studying the universe.
4. Planetary Defence – We track asteroids, solar flares and gamma ray bursts to see if they are risks to Earth.
5. Space Exploration – Understanding things like radiation cosmic rays and gravitational fields helps us have trips to space.
6. Fundamental Science – We often start looking for particles and dark matter by studying the universe.
7. Inspiration – Finding out things about the universe makes people interested in science and helps us understand our place in it.

Advantages of Studying Cosmic Phenomena

1. We learn more about how the universe works in situations.
2. We get technologies that can help us in everyday life like better medical imaging and GPS.
3. We can. Prepare for space weather that might affect Earth.
4. We make our navigation and communication systems better.
5. We challenge what we think we know which helps us make discoveries.
6. We get an idea of Earths future and our place in the universe.
7. We inspire ideas, teamwork and working together across different areas of study.
8. Cosmic phenomena help us understand the universe and its mysteries.
9. Studying phenomena is important, for our understanding of the universe.
10. The universe and its phenomena are still not fully understood.

General Relativity:

General Relativity is Einstein's 1915 theory of gravity. This theory is very important. It changed the way we think about gravity. Before people thought, gravity was a force. Einstein said that mass and energy actually change the shape of space-time. That shape tells objects how to move. For example, planets go around stars because of this. Light bends when it goes near stars. Time goes slower when gravity is strong. This is because space-time is always changing. When gravity is weak, General Relativity is similar to Newton's idea of gravity. When gravity is strong, it makes different predictions. General Relativity has uses. Here are a few:

1. GPS and Navigation: Satellites have clocks that run faster when gravity is weak. They run slower when they are moving. GPS takes both of these effects into account so it can stay accurate.
2. Astrophysics: General Relativity helps us understand holes, neutron stars and how stars move around each other.
3. Cosmology: It helps us understand how the universe began and how it is still growing.
4. Gravitational Wave Astronomy: Scientists use General Relativity to detect waves in space-time that are made when black holes or neutron stars crash into each other.

5. Space Missions: General Relativity is used to plan the paths of spacecraft and to do experiments in space.
6. Fundamental Tests: Scientists are always testing General Relativity with clocks and spacecraft to see how well it works.
7. Imaging: General Relativity helps us see away galaxies by bending light around them.

General Relativity has advantages. It describes gravity precisely. It combines space and time into one framework. It helps us make technologies. It predicts things that we later discover. It gives us a model of the universe. It helps us test ideas. It connects abstract ideas to real effects. General Relativity is an important theory. It is used in areas of science. It has led to many new discoveries.

Conclusion

From times to today, it has changed alongside human thought, science and technology. The Egyptians and Babylonians used math for measurement, astronomy, trade and building. Chinese, Greek, Indian, Islamic and European mathematicians added to math knowledge in areas like geometry, algebra and calculus. Each group had ideas that helped shape modern math. The history of math shows that human progress is linked to math understanding. Every big step in science, engineering, navigation, communication and computing relied on math. Math helps us understand patterns order and the structure of reality.

The I Ching showed ideas of balance and change through symbols. Concepts like Yin and Yang represented opposing forces that are connected. This idea is similar to systems and computer thinking. The rise of Artificial Intelligence in the century is a new stage in math evolution. AI changes how we learn, use and research math. In education AI, systems give learning, explanations and feedback. These technologies help students understand math concepts better. AI tools like Wolfram Alpha and MATLAB make complex math tasks easier. AI also helps with discovery and research. Modern math relies on algorithms, simulations and data analysis. The calculation of trillions of digits of π shows how math and computing work together. AI-assisted systems speed up calculations. Identify patterns in large datasets. Math and AI are crucial in understanding the universe.

Concepts like holes and gravitational waves are explained using advanced math models. General Relativity, introduced by Albert Einstein in 1915 changed our understanding of gravity. This theory explained motion and the expansion of the universe. It showed how abstract math could describe reality. The applications of General Relativity still influence technology and research. GPS systems need corrections to stay accurate. Astrophysicists use the theory to study stars, galaxies and gravitational waves. AI helps by analyzing telescope data and simulating events. Studying the universe provides benefits to humanity. It drives innovation improves navigation and communication and inspires curiosity. Research encourages collaboration across disciplines and nations.

Many aspects of the universe remain unknown like matter and quantum gravity. These questions motivate math and scientific exploration. In conclusion, mathematics is a language that helps humanity understand the world and the universe. The evolution of mathematics laid the foundation for science and technology. Artificial Intelligence enhances this foundation by improving math learning and enabling discoveries. Together mathematics and AI are a combination, in modern civilization. Their continued

development will shape advancements in education, science, and technology and space exploration.

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Wolfram Alpha Official Website

MATLAB Official Website

Impact of Socioeconomic Status on Students' Access to Technology and Digital Literacy

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Abstract

Socioeconomic status (SES) significantly influences students' access to technology and the development of digital literacy skills, which are critical for academic success in today's learning environment. This study highlights how SES impacts students' availability of digital devices, internet connectivity, and opportunities to engage with technology for educational purposes. Students from higher socioeconomic backgrounds generally have greater access to personal computers, stable internet connections, and supportive home learning environments, enhancing their digital competencies. Conversely, students from lower socioeconomic backgrounds often face limited device ownership, unreliable internet, and reduced exposure to technology-rich learning contexts, which can hinder digital skill development. The research also examines how these disparities affect participation in online learning, independent study, and information-seeking behaviors. Furthermore, it highlights the role of schools and policy interventions in mitigating these gaps through the provision of digital resources, inclusive teaching strategies, and technology-integrated programs. Findings underscore that bridging the digital divide is essential for equitable academic outcomes, ensuring all students can develop the digital literacy necessary to succeed in modern education.

Keywords: Academic Outcomes, Digital Divide, Digital Literacy, Socioeconomic Status, Technology Access

Introduction

Technology has transformed the educational system across the world. Digital tools such as laptops, smartphones, tablets, and internet-based learning platforms have become important components of teaching and learning. Educational institutions increasingly rely on online learning systems, digital assignments, and virtual classrooms. As a result, digital literacy has become an essential skill for students. Digital literacy refers to the ability to use digital technologies effectively for communication, learning, research, and problem solving. Students with strong digital literacy skills can access educational information, participate in online discussions, and complete academic tasks more efficiently. However, students' access to technology and digital literacy development are strongly influenced by socioeconomic status.

Socioeconomic status refers to the economic and social condition of individuals based on income, education, and occupation. Students from economically stronger families generally have better access to personal computers, smartphones, internet facilities, and supportive learning environments. In contrast, students from lower-income families often experience limited access to digital resources, inadequate internet connectivity, and fewer opportunities

to develop technological skills. The COVID-19 pandemic further exposed inequalities in digital education. Many students from disadvantaged backgrounds struggled to attend online classes due to lack of devices and poor internet access. These inequalities contribute to the digital divide, which creates barriers to academic achievement and social inclusion.

This study focuses on understanding how socioeconomic status affects students' access to technology and digital literacy using responses collected from 50 students.

Review of Related Literature

Paul Attewell (2001) explained that unequal access to technology creates educational inequalities among students from different socioeconomic backgrounds. The study highlighted that students from affluent families have greater technological exposure and digital skills.

Neil Selwyn (2004) stated that the digital divide is not only related to physical access to technology but also to the quality of technology usage and digital competencies. UNESCO (2020) emphasized that digital literacy is essential for inclusive and quality education. The report highlighted the need for equal technological opportunities for students.

Organisation for Economic Co-operation and Development (2021) reported that socioeconomic inequalities significantly affect students' participation in online learning and digital readiness.

Objectives

1. To analyze the relationship between socioeconomic status and students' access to technology.
2. To examine the impact of socioeconomic status on digital literacy skills.
3. To identify the challenges faced by students during online learning.
4. To suggest measures to reduce the digital divide in education.

Methodology

The study is descriptive in nature and is based on both primary and secondary data.

Primary Data

Primary data were collected from 50 college students using a structured questionnaire. The questionnaire included questions related to family income, digital device ownership, internet access, online learning experiences, and digital literacy skills.

Secondary Data

Secondary data were collected from books, journals, government reports, and educational websites related to digital literacy and socioeconomic inequality.
The study uses percentage analysis to interpret the responses collected from students. The data help in understanding the relations

Analysis

The study reveals significant disparities in technology access and digital literacy across socioeconomic groups. Students from higher-income families possess personal laptops, stable internet, and supportive learning environments, facilitating effective online

engagement and skill development. Conversely, students from lower-income backgrounds face device shortages, unreliable connectivity, and limited exposure to digital tools, hindering their learning outcomes. The analysis demonstrates that these gaps amplify educational inequities, affecting participation, independent study, and academic performance. Data from surveys and comparative tables highlight that access to devices and digital competencies is directly correlated with socioeconomic status, emphasizing the need for inclusive policies and interventions.

Findings and Discussion

Table 1: Socioeconomic Background of Respondents

Income Level	Number of Respondents	Percentage
Low Income	20	40%
Middle Income	18	36%
High Income	12	24%
Total	**50**	**100%**

Source: Primary Data

The table shows that 40% of respondents belong to low-income families, while 36% belong to middle-income families and 24% belong to high-income families. This indicates that many students come from economically weaker sections.

Table 2: Availability of Digital Devices

Type of Device	Number of Respondents	Percentage
Personal Laptop	18	36%
Smartphone Only	25	50%
Shared Device	7	14%
Total	**50**	**100%**

Source: Primary Data

The table reveals that only 36% of students own personal laptops. Half of the respondents depend mainly on smartphones for educational activities, while 14% share devices with family members.

Table 3: Internet Connectivity of Students

Type of Internet Access	Number of Respondents	Percentage
Broadband/Wi-Fi	16	32%
Mobile Data	26	52%
Unstable Internet	8	16%
Total	**50**	**100%**

Source: Primary Data

The data indicate that most students depend on mobile data for internet access. Students with unstable internet connectivity face interruptions during online classes and academic activities.

Table 4: Digital Literacy Level

Digital Literacy Level	Number of Respondents	Percentage
High	15	30%
Moderate	22	44%
Low	13	26%
Total	**50**	**100%**

Source: Primary Data

The table shows that only 30% of respondents possess high digital literacy skills, while 26% have low digital literacy. Students from higher socioeconomic backgrounds generally demonstrate better digital competencies.

Table 5: Challenges Faced During Online Learning

Challenges	Number of Respondents	Percentage
Lack of Devices	14	28%
Poor Internet Connectivity	18	36%
Lack of Technical Skills	10	20%
Financial Problems	8	16%
Total	**50**	**100%**

Source: Primary Data

The table highlights that poor internet connectivity is the major challenge faced by students during online learning. Lack of devices and technical skills also affect students' participation in digital education. The study clearly indicates that socioeconomic status significantly influences students' access to technology and digital literacy. Students from high-income families generally have access to laptops, high-speed internet, and supportive learning environments. These advantages enable them to participate effectively in online learning and improve their academic performance.

In contrast, students from low-income families face several barriers in digital education. Many students rely only on smartphones for attending online classes and completing assignments. Some students also share devices with family members, reducing their study time and educational participation. The findings also reveal that internet connectivity remains a major problem for economically disadvantaged students. Poor internet access interrupts online classes, delays assignment submissions, and reduces learning efficiency. In addition, students with limited technological exposure often lack confidence in using educational software and digital platforms.

The digital divide creates educational inequality by limiting opportunities for students from lower socioeconomic backgrounds. Therefore, educational institutions and governments must adopt inclusive strategies to ensure equal technological access and digital literacy development.

Findings of the Study

- The study reveals that socioeconomic status strongly influences students' access to technology and digital literacy skills. Students from higher-income families generally possess better technological resources such as personal laptops, broadband internet, and

access to online learning platforms. In contrast, students from lower-income families face challenges related to device availability and internet connectivity.

- The research also shows that many students depend mainly on smartphones for educational activities. While smartphones provide basic access to online learning, they are less effective for academic tasks such as preparing assignments, attending long online classes, and conducting detailed research.

- Another important finding is that poor internet connectivity significantly affects students' participation in online education. Students with unstable internet access face interruptions during classes and difficulties in accessing digital learning materials.

- The study further indicates that students from economically stronger backgrounds possess higher digital literacy skills compared to students from weaker socioeconomic groups. Financial limitations and reduced exposure to technology contribute to lower digital competence among disadvantaged students.

- Overall, the findings highlight that socioeconomic inequality remains a major factor contributing to the digital divide in education.

Suggestions

- The study suggests that educational institutions and governments should provide free or subsidized digital devices to economically disadvantaged students. Access to laptops and tablets would improve students' participation in online learning and academic activities.

- Affordable and reliable internet services should be expanded, especially in rural and low-income areas. Better internet connectivity would ensure uninterrupted access to digital education.

- Educational institutions should also organize digital literacy training programs to help students develop technological skills. Training in educational software, online communication tools, and digital research methods would improve students' confidence and learning efficiency.

- Teachers should adopt inclusive teaching methods that support students with limited technological access. Providing recorded lectures, offline learning materials, and flexible submission options can help disadvantaged students continue their education effectively.

- Finally, collaboration between governments, educational institutions, and private organizations is necessary to strengthen digital infrastructure and reduce educational inequality.

Conclusion

The study concludes that socioeconomic status has a significant impact on students' access to technology and digital literacy. Economic inequalities create differences in device ownership, internet access, and technological skills among students. Students from higher socioeconomic backgrounds benefit from better technological resources and supportive learning environments, while students from lower-income families face several challenges in digital education.

The digital divide negatively affects students' academic participation, learning experiences, and future opportunities. Therefore, reducing technological inequality is essential for ensuring inclusive and equitable education. Educational institutions, policymakers, and governments must work together to provide affordable technology, internet access, and digital literacy training for all students. Equal access to digital education will help students succeed academically and prepare them for future employment in the digital age.

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From Oral Assessment Findings to Digital Intervention: AI-Assisted Development of an Interactive Cartesian Coordinate Learning Application

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Abstract
Many university students continue to experience difficulties in understanding the Cartesian coordinate system, particularly in identifying coordinate points, distinguishing axes, determining quadrants, and interpreting coordinate movement. These difficulties emerged from an oral assessment conducted within a vector-related mathematics examination, in which students' responses indicated weaknesses in prerequisite Cartesian coordinate concepts. Therefore, this study aims to develop an interactive Cartesian coordinate learning application through an AI-assisted development process as a digital intervention to address these conceptual difficulties. The study also seeks to demonstrate how diagnostic findings from oral assessment can be translated into a targeted instructional solution that supports visualization and active learning. This study employed an initial cycle of Design-Based Research consisting of four stages: problem identification, formulation of instructional design requirements, application development, and initial evaluation. The application was developed as an HTML-based interactive learning environment, with generative AI used to support the design and coding process. Following development, the same 50 students independently used the application, and their responses were collected through a questionnaire. The initial evaluation suggests that the application provided a structured and engaging learning experience that supported students in visualizing coordinate movement and understanding relationships among axes, points, and quadrants. These findings indicate that AI-assisted application development can support the creation of targeted digital interventions in mathematics learning. The study further highlights the importance of grounding instructional design in students' actual learning difficulties.

Keywords: AI-Assisted Development, Cartesian Coordinate System, Digital Intervention, Interactive Learning Application, Oral Assessment

Introduction

Sustainable Mathematics plays an essential role in developing logical reasoning, analytical thinking, and problem-solving abilities. One foundational topic is the Cartesian coordinate system, which supports the understanding of geometry, functions, graph

interpretation, and vector representation. Learning Cartesian coordinates requires students to connect symbolic information, such as ordered pairs, with spatial positions on a plane. From a cognitive perspective, this connection involves conversion between semiotic representations, a process that is central to mathematical understanding but can also become a source of learning difficulty (Duval, 2006).

Difficulties in coordinate representation may appear when students identify ordered pairs, distinguish horizontal and vertical axes, determine quadrants, or interpret movement on the Cartesian plane. These weaknesses are important because they can interfere with students' engagement in more advanced visual and spatial topics, including graphical vector representation. Prior research has also shown that mathematical misconceptions often persist when foundational concepts are not fully understood (Jamaludin & Maat, 2020).

Identifying such difficulties requires assessment approaches that reveal how students reason, not merely, whether their final answers are correct. Oral assessment allows instructors to probe students' explanations, observe hesitation and representational confusion, and obtain richer evidence of conceptual understanding than static written responses alone (Theobold, 2021; Hankeln et al., 2025). In this study, difficulties related to Cartesian coordinates emerged during an oral examination on vector-related tasks, where students were required to represent mathematical ideas graphically. These findings were treated as diagnostic evidence for designing a targeted instructional intervention.

Digital learning environments offer opportunities to support mathematics learning through visualization, interaction, and structured practice. Meta-analytic evidence suggests that digital tools can contribute positively to mathematics learning when their design is aligned with the learning task and pedagogical purpose (Hillmayr et al., 2020). Interactive digital learning activities can also encourage students to engage actively with mathematical processes and revise their responses through structured interaction (Barana et al., 2021). At the same time, the growing use of artificial intelligence in education creates opportunities to support the development of digital learning interventions, if its use remains pedagogically grounded and connected to actual learning needs (Zawacki-Richter et al., 2019; Govender, 2025). However, the value of such digital interventions depends on whether they are designed in response to specific learning difficulties rather than developed as general-purpose technological tools.

Therefore, this study aims to develop an interactive Cartesian coordinate learning application through an AI-assisted development process based on findings from oral assessment. Specifically, it seeks to identify students' conceptual difficulties in Cartesian coordinate understanding, translate these findings into instructional design requirements, develop a targeted digital intervention, and conduct an initial evaluation of students' responses to the application.

Review of Related Literature

A growing body of research highlights the importance of addressing students' conceptual difficulties in mathematics through targeted digital interventions. Duval (2006) emphasizes that comprehension challenges often stem from the need to convert between semiotic representations, a process central to understanding Cartesian coordinates. Misconceptions in foundational topics, such as ordered pairs and quadrants, can persist and hinder advanced learning (Jamaludin & Maat, 2020). Oral assessment has been

shown to provide richer diagnostic evidence of students' reasoning, capturing hesitation and representational confusion more effectively than written responses (Theobold, 2021; Hankeln et al., 2025).

Digital learning environments offer promising avenues to support these needs. Meta-analytic findings confirm that well-designed digital tools can enhance mathematics learning when aligned with pedagogical goals (Hillmayr et al., 2020). Interactive feedback mechanisms foster active engagement and iterative improvement in mathematical reasoning (Barana et al., 2021; Smit et al., 2023), while outdoor and contextualized digital feedback further enrich learning experiences (Jablonski, 2024). The integration of artificial intelligence into education has been widely explored, with systematic reviews noting its potential but stressing the importance of pedagogical grounding (Zawacki-Richter et al., 2019). Govender (2025) underscores that contextual factors and resource availability must be considered when implementing AI-based tools in mathematics education.

Recent design-based research studies (Reilly & Reeves, 2023; Richardson et al., 2025; Sathya & Alamelu, 2026) demonstrate how digital competence and transdisciplinary approaches can strengthen instructional design and teacher practice. Collectively, these studies suggest that AI-assisted, interactive applications tailored to diagnostic findings—such as those from oral assessments—can effectively address specific learning difficulties in Cartesian coordinates and contribute to deeper mathematical understanding.

Objectives

The objectives of the article are to identify students' difficulties in Cartesian coordinate representation through oral assessment and to analyze misconceptions related to ordered pairs, axes, quadrants, and movement on the plane. It seeks to connect semiotic representations between symbolic information and spatial positions, while using oral examination as diagnostic evidence of conceptual understanding. The study aims to translate assessment findings into instructional design requirements and develop a targeted digital intervention addressing specific learning difficulties. It emphasizes the integration of visualization and interaction into the learning application and the application of AI-assisted development in creating the interactive Cartesian coordinate tool. Finally, the study intends to evaluate students' responses to the application during initial implementation and to contribute to mathematics learning by aligning digital tools with pedagogical purpose.

Methodology

Research Design and Participants

This study employed an initial cycle of Design-Based Research (DBR) to develop an interactive Cartesian coordinate learning application through an AI-assisted development process. DBR was selected because the study aimed to address an educational problem identified in an authentic learning context and translate it into a targeted instructional intervention. The research process consisted of four interconnected stages: (1) problem identification through oral assessment, (2) formulation of instructional design requirements, (3) AI-assisted application development, and (4) initial evaluation of the developed application (Reilly & Reeves, 2023; Richardson et al., 2025; Sathya & Alamelu, 2026). The overall research process is presented in Figure 1.

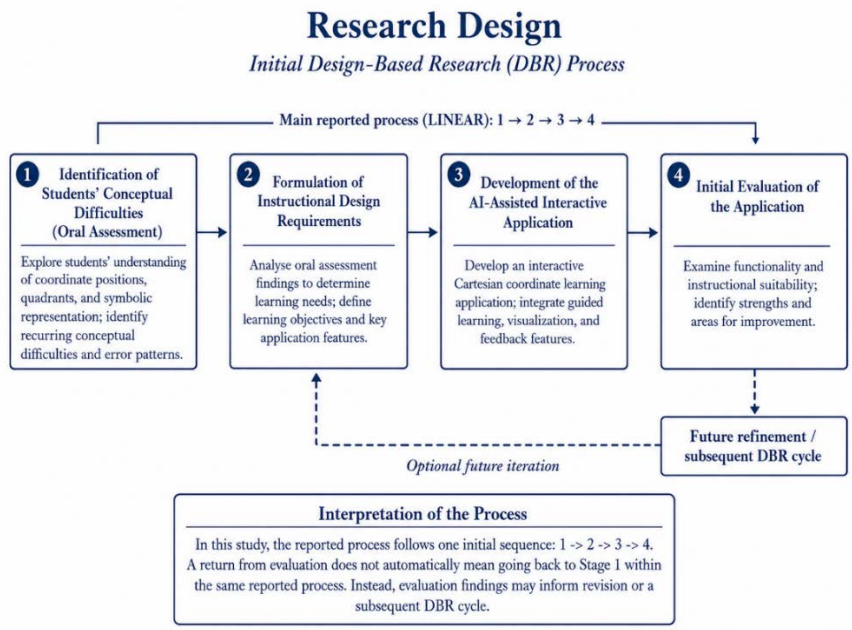

Figure 1. Initial Design-Based Research Process of the Study

A total of 50 university students from an engineering programme participated in this study. These students had previously encountered Cartesian coordinate concepts in earlier mathematics learning, making them relevant participants for examining persistent difficulties in coordinate understanding. The same group was involved in both the initial problem-identification stage and the initial evaluation of the developed application.

Analysis

Oral Assessment-Based Problem Identification

The initial learning problem was identified from an individual oral examination conducted as part of a mathematics course assessment. The examination focused primarily on vector-related concepts. During the assessment, each student was questioned directly by the lecturer and asked to explain mathematical ideas, perform calculations, and represent selected tasks graphically. One task required students to determine the result of vector addition and illustrate the vectors on a Cartesian plane.

Although the oral examination was originally administered for classroom assessment purposes, students' responses provided diagnostic information relevant to this study. Because the vector representation task required prerequisite understanding of Cartesian coordinates, the oral responses were subsequently reviewed to identify recurring conceptual difficulties related to coordinate representation. The review focused not only on the final correctness of students' answers, but also on the patterns of hesitation, confusion, and representational errors that appeared during their explanations and graphical work. The recurring patterns identified through this review were then used to formulate the instructional design requirements of the application.

AI-Assisted Application Development

The identified conceptual difficulties were translated into instructional design requirements focusing on students' understanding of: (1) the Cartesian plane and the orientation of the axes, (2) ordered pairs and point location, (3) quadrant positions, and (4) coordinate movement as a basis for interpreting displacement on the plane. These

requirements served as the pedagogical foundation for determining the scope, learning flow, and interaction logic of the digital intervention.

Based on these requirements, an HTML-based interactive Cartesian coordinate learning application was developed. Generative AI was used to support the development process, particularly in structuring the interface, generating and refining code, and implementing the planned interaction logic. The use of AI enabled the instructional ideas derived from the oral assessment findings to be translated more efficiently into a functional prototype. In this study, the term AI-assisted refers to the use of AI as a development support tool rather than as an AI tutoring system embedded in the application.

Initial Evaluation and Data Analysis

After development, the same 50 students were asked to use the application independently. Following the activity, students completed a response questionnaire that explored their perceptions of the application in relation to conceptual understanding, engagement, confidence during learning, and usability.

The data were analysed descriptively. Oral assessment responses were reviewed to identify recurring patterns of conceptual difficulty that informed the application design. Supporting oral assessment records, including students' vector-task scores, were used to contextualise the identified learning problems. Students' questionnaire responses were summarised descriptively to examine their perceptions of the application, while open-ended responses were grouped into recurring categories to identify difficulties that remained after using the digital intervention.

Findings and Discussion

Oral Assessment Findings as the Basis for Digital Intervention

The oral assessment conducted in the vector-related mathematics examination revealed that students' difficulties in graphical vector representation were closely connected to weaknesses in prerequisite Cartesian coordinate concepts. During the examination, several students showed uncertainty when locating ordered pairs, distinguishing the horizontal and vertical axes, identifying quadrants, and interpreting coordinate movement on the plane. These difficulties emerged when students were required to explain and draw vectors graphically, indicating that the problem was not limited to vector operations, but also involved foundational spatial and representational understanding.

The distribution of students' scores in the vector oral assessment is presented in Table 1. Among the 50 students, scores ranged from 0 to 100, with a mean score of 59 and a median score of 50. The most frequent score was 50, obtained by 15 students, while 14 students achieved a score of 100. Although these scores were not interpreted as a direct measure of Cartesian coordinate mastery, the variation in performance provided contextual evidence that students differed substantially in their ability to complete graphically oriented vector tasks.

Table 1. Distribution of Students' Scores in the Vector Oral Assessment

Score	Number of Students
0	5
25	8

50	15
75	8
100	14
Total	50

Source: Authors' analysis of oral assessment records

The oral assessment played an important diagnostic role in making students' underlying conceptual difficulties visible. Rather than relying only on numerical scores or final written answers, the oral format allowed the lecturer to observe students' explanations, hesitation, and representational confusion during the vector task. This aligns with previous studies showing that oral responses can provide richer insight into students' conceptual understanding and reasoning processes (Theobold, 2021; Hankeln et al., 2025).

In this study, the oral assessment functioned not only as an evaluation of vector-related performance, but also as a source for identifying prerequisite learning problems in Cartesian coordinate understanding. Students' difficulties in graphical vector representation indicated challenges in coordinating symbolic and spatial representations, consistent with Duval's (2006) view that conversion between representation forms is central to mathematical comprehension. Accordingly, the findings were treated as diagnostic evidence for determining the focus of the digital intervention rather than as a direct measure of overall coordinate competence.

Based on recurring patterns in the oral responses, four central learning difficulties were identified: understanding the orientation of the axes, locating ordered pairs accurately, identifying quadrant positions, and interpreting movement or displacement on the Cartesian plane. These difficulties became the conceptual basis for the application, ensuring that the digital intervention was developed in response to a specific instructional need rather than from a general intention to introduce technology into mathematics learning.

Developed Interactive Cartesian Coordinate Learning Application

Based on the oral assessment findings, an HTML-based interactive Cartesian coordinate learning application was developed through an AI-assisted development process. The application was designed to help students connect coordinate notation with spatial movement by navigating a character toward target points on a Cartesian plane. A visual overview of the application interface and its coordinate-navigation environment is presented in Figure 2.

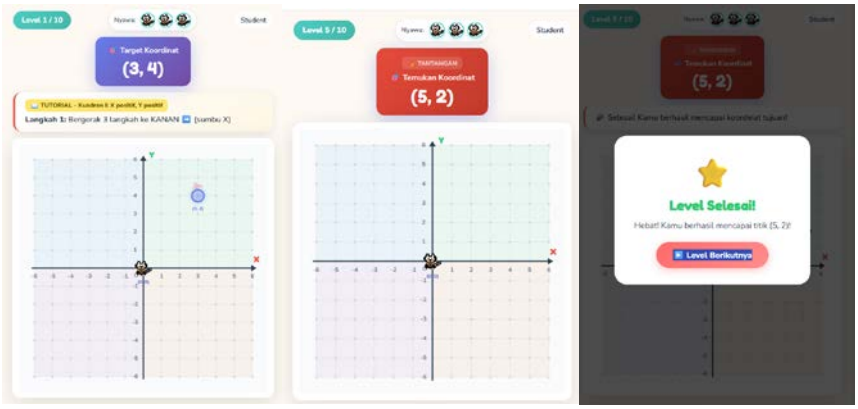

Figure 2. Interface of the Interactive Cartesian Coordinate Learning Application

The application includes guided and challenge-oriented coordinate tasks. In the guided stage, students receive systematic support for moving along the x- and y-directions, while in the challenge stage they determine the required movement independently. Students are presented with target coordinates and must navigate the character across the Cartesian plane until the intended position is reached. An error-sensitive mechanism is also embedded: incorrect movement or movement beyond the intended coordinate reduces students' available lives, encouraging closer attention to coordinate direction, magnitude, and positional accuracy.

The application design directly reflects the diagnostic findings from the oral assessment. Difficulties in distinguishing x- and y-coordinates informed the use of horizontal and vertical movement tasks; difficulties in locating points informed target-coordinate navigation; and difficulties in interpreting movement informed stepwise displacement activities. Through this structure, students do not merely read coordinate information, but actively translate symbolic coordinates into visible movement on the plane. Thus, the application was developed not as a generic mathematics game, but as a targeted intervention, responding to specific conceptual difficulties identified in an authentic assessment context.

This design is consistent with evidence that digital tools are more educationally meaningful when their features are aligned with clear pedagogical purposes and specific learning tasks (Hillmayr et al., 2020). The application's interactive structure allows students to act on coordinate information, observe the consequences of their decisions, and revise their movement when errors occur. Such interaction is aligned with digital mathematics learning approaches that support active engagement and iterative improvement through feedback-informed activity (Barana et al., 2021; Jablonski, 2024).

Generative AI in translating instructional ideas into functional interface elements and interaction logic supported the development process. However, the pedagogical direction remained grounded in the researcher's interpretation of students' oral assessment findings. In this sense, AI functioned as a development support tool rather than as an autonomous instructional agent, consistent with calls for AI use in education to remain context-sensitive and pedagogically grounded (Zawacki-Richter et al., 2019; Govender, 2025).

Students' Initial Responses to the Application

After independently using the application, students completed a response questionnaire. The descriptive results are summarised in Table 2. Overall, students reported positive perceptions across four aspects: conceptual understanding, confidence and persistence, engagement, and usability. As presented in Table 2, the highest mean score was found in usability and clarity ($M = 3.61$), followed by confidence and persistence ($M = 3.53$), conceptual understanding ($M = 3.48$), and engagement ($M = 3.42$).

Table 2. Summary of Students' Responses after Using the Application

Aspect	Mean Score
Conceptual understanding	3.48
Confidence and persistence	3.53
Engagement	3.42
Usability and clarity	3.61

The strongest response appeared in the aspect of usability and clarity. This suggests that students generally perceived the application as understandable and manageable to use. This result is important because the intervention was intended to address concepts that students had previously found confusing in an oral assessment context. If the application interface or task structure had been difficult to follow, the digital medium could have added a new layer of cognitive burden. Instead, the high perception of usability indicates that the application was able to present Cartesian coordinate tasks in a form that students considered accessible. This supports the importance of designing digital mathematics tools whose technical operation does not distract from the conceptual learning objective. Hillmayr et al. (2020) similarly emphasise that the effectiveness of digital tools depends on how appropriately they are integrated with the learning purpose and task structure, not simply on the presence of technology itself.

The second-highest mean score was found in confidence and persistence. This is a meaningful result because students had previously displayed hesitation and confusion during the oral assessment when working with coordinate-related aspects of vector representation. The application has guided movement tasks, repeated attempts, and visible task progression may have helped create a lower-risk space for students to try, make errors, and continue. In digital mathematics learning, persistence can be supported when students receive immediate indications of their actions and have opportunities to revise their responses rather than being positioned only as right or wrong. Barana et al. (2021) argue that interactive feedback can encourage learners to actively close the gap between their current and desired performance. The present finding is also compatible with Jablonski's (2024) observation that feedback indicating an error can stimulate verification and further reasoning rather than merely signalling failure.

The mean score for conceptual understanding was also positive. Students' responses suggest that the application helped them perceive coordinate-related ideas more clearly, particularly through the visualisation of movement on the Cartesian plane. This is consistent with the initial purpose of the intervention: to strengthen the connection between numerical coordinate notation and spatial representation. The finding is

conceptually aligned with Duval's (2006) perspective that mathematical understanding depends on the coordination of different representation systems. By requiring students to translate target coordinates into movement decisions, the application creates opportunities for them to connect symbolic information, spatial position, and directional action. Although this study did not yet measure learning gains through a pre-test–post-test design, the positive perception in conceptual understanding indicates that students experienced the application as supportive of the conceptual difficulties it was intended to address.

The engagement aspect received the lowest mean score among the four aspects, although it remained positive overall. This result should not be interpreted as a weakness of the application, but rather as a useful direction for refinement. The application appears to have been perceived as clear, confidence supporting, and conceptually helpful; however, engagement may be further strengthened through richer task variation, more progressive levels of challenge, expanded feedback, or additional forms of interactive reward. Research on mathematics learning environments suggests that interaction alone does not automatically guarantee sustained engagement; rather, engagement is strengthened when tasks are meaningfully challenging, feedback is informative, and students can actively participate in improving their reasoning (Barana et al., 2021; Smit et al., 2023). Smit et al. (2023), for example, highlight the importance of feedback-rich interaction in supporting mathematical reasoning, suggesting that future iterations of the application may benefit from more elaborated prompts or feedback messages that guide students to reflect on why a movement is correct or incorrect.

The open-ended questionnaire responses further contextualised the quantitative findings. A total of 28 students stated that they no longer experienced major difficulties after using the application. This response is encouraging because it suggests that, for many students, the intervention was perceived as sufficient to reduce the coordinate-related confusion they had encountered earlier. However, several students still reported remaining challenges, including determining points according to instructions, reading points from coordinate images, distinguishing x- and y-values, and identifying quadrants. These remaining difficulties are important because they show that the intervention addressed some aspects of students' needs while also revealing areas that require further scaffolding.

From a design-based research perspective, these remaining challenges are not merely limitations; they are also valuable inputs for the next cycle of refinement. The initial application was developed in response to diagnosed learning needs and was positively received, but the open-ended responses indicate that some concepts may require representation that is more explicit, additional guided examples, or repeated transitions between symbolic and visual forms. For example, difficulty distinguishing x- and y-values may be addressed through enhanced visual cues and comparison tasks, while difficulty-identifying quadrants may benefit from focused activities that repeatedly connect the signs of coordinates with quadrant positions. Such refinements would strengthen the alignment between the application's instructional features and the specific misconceptions or uncertainties that persist among students.

The overall findings therefore suggest that the application functioned as a promising initial intervention. It was perceived positively across all measured aspects and appeared to respond meaningfully to the coordinate-related difficulties that informed its development. At the same time, the findings should be interpreted within the scope of an

early DBR cycle and a perception-based initial evaluation. The results support the feasibility and instructional relevance of translating oral assessment findings into a targeted digital learning application, but they do not yet establish causal effectiveness in improving students' mathematical achievement. Future empirical testing is needed to determine whether the application leads to measurable improvements in coordinate understanding and transfer to vector representation tasks.

Limitations and Future Research

Despite these promising initial findings, this study has several limitations. First, the study focused on a single group of 50 students from one university learning context, which limits the generalisability of the findings. Second, the evaluation was based primarily on students' perceptual responses after using the application and did not yet include a pre-test–post-test comparison or an experimental design to examine learning gains more rigorously. Third, the application was developed to address coordinate-related difficulties identified during a vector-related oral assessment, so its effectiveness for broader Cartesian coordinate learning contexts still requires further investigation.

Future research may extend this study by involving larger and more diverse student groups, conducting experimental or quasi-experimental evaluations, and examining the application's effects on students' conceptual understanding and transfer to vector representation tasks. Further development may also explore iterative refinement of the application based on students' remaining difficulties, as well as more advanced AI-supported design processes for creating targeted mathematics learning interventions.

Conclusion

This study developed an interactive Cartesian coordinate learning application through an AI-assisted development process based on conceptual difficulties identified from oral assessment findings. The oral assessment, originally conducted within a vector-related mathematics examination, revealed that students experienced difficulties in prerequisite coordinate concepts, including locating ordered pairs, distinguishing axes, determining quadrants, and interpreting coordinate movement. These findings were then translated into instructional design requirements that guided the development of the digital intervention.

The resulting application provided a visual and interactive learning environment designed to support students' understanding of coordinate positions and movement on the Cartesian plane. Students' initial responses indicated positive perceptions of the application across conceptual understanding, confidence and persistence, engagement, and usability. These findings suggest that transforming assessment-based diagnostic insights into targeted digital interventions can offer a meaningful approach to supporting foundational mathematics learning.

This study also demonstrates the potential of generative AI as a support tool in the development of educational applications, particularly for translating instructional ideas into functional digital prototypes. However, the findings should be interpreted as initial evidence from an early DBR cycle rather than as conclusive proof of learning effectiveness. Further research is needed to examine the application through broader implementation, experimental or quasi-experimental evaluation, and refinement based on students' remaining learning difficulties.

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Students' Perceptions of an AI-Assisted Interactive Cartesian Coordinate Application

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Abstract
Students often experience difficulties in understanding Cartesian coordinate concepts, particularly in interpreting coordinate representations and connecting symbolic forms with spatial visualization. To address these challenges, this study examined university students' perceptions of an AI-assisted interactive application designed to support learning of Cartesian coordinates. The study focused on three aspects: conceptual understanding, learning motivation, and usability. A quantitative descriptive approach was employed involving 75 undergraduate students who interacted with the application during a guided learning session. Data were collected using a structured questionnaire and analysed using descriptive statistics. The findings revealed positive student perceptions across all measured aspects, with an overall mean score of 3.39 on a 4-point Likert scale. The highest ratings were found in usability and visual representation, indicating that the application was perceived as easy to use and effective in supporting spatial interpretation of coordinate concepts. Students also reported increased motivation, confidence, and willingness to retry after making mistakes during learning activities. Although several students initially had trouble in distinguishing coordinate positions and quadrants, repeated interaction with the application helped reduce misconceptions. These findings suggest that AI-assisted interactive learning applications have strong potential to support conceptual understanding and engagement in mathematics learning, particularly in topics requiring visual-spatial reasoning.

Keywords: AI-Assisted Learning, Cartesian Coordinate System, Interactive Learning Application, Student Perception

Introduction

Sustainable Mathematics plays an important role in developing analytical thinking and spatial reasoning skills needed to understand abstract concepts and solve real-world problems. One of the foundational topics in mathematics education is the Cartesian coordinate system, which supports the understanding of more advanced concepts such as functions, geometry, and graph interpretation. Despite its importance, many students continue to experience difficulties in understanding Cartesian coordinates, particularly in identifying points, interpreting ordered pairs, and connecting symbolic representations with their positions on the coordinate plane (Guven, 2022). These difficulties are not solely caused by limited procedural skills but are also associated with weak conceptual

understanding and insufficient spatial reasoning abilities (Duffy et al., 2024; Guven, 2022). Guven (2022), for example, reported that many students perceive coordinates merely as labels on a graph rather than as directed distances from the origin. Similarly, Duffy et al. (2024) found that students often rely on procedural approaches without fully understanding the relationships between numerical values and spatial representations.

The limitations of procedural understanding become more evident when students are required to apply mathematical concepts in unfamiliar contexts. In mathematical problem-solving activities, students frequently struggle to translate relational information into mathematical representations because they are unable to construct accurate mental models of the problem situation, a process strongly associated with spatial ability (Duffy et al., 2024). Therefore, conceptual understanding is considered a central component of effective mathematics learning, as it enables students to connect multiple representations, reason flexibly, and construct meaningful mathematical knowledge (National Council of Teachers of Mathematics [NCTM], 2014; Guven, 2022). The NCTM (2014) further emphasizes that meaningful mathematics instruction should encourage students to reason mathematically and understand relationships among mathematical ideas rather than rely solely on memorized procedures.

In response to these challenges, the integration of technology into mathematics education has received increasing attention in recent years (OECD, 2021). Interactive digital learning environments, including augmented reality (AR) applications and visualization-based tools, allow students to manipulate objects, explore representations dynamically, and receive immediate feedback during learning activities (Kaźmierczak et al., 2025; OECD, 2021). Such features are particularly beneficial in mathematics learning because they support students in connecting symbolic and visual representations more effectively. More recently, developments in artificial intelligence (AI) have expanded these possibilities by enabling adaptive feedback, personalized guidance, and real-time scaffolding during learning activities (Kasneci et al., 2023; Zawacki-Richter et al., 2019).

AI-assisted interactive applications are especially relevant for topics involving spatial reasoning and coordinate interpretation because they combine visualization with intelligent feedback mechanisms (Kaźmierczak et al., 2025). Previous studies have shown that interactive visualization tools can improve students' engagement, spatial reasoning, and motivation in mathematics learning (Kaźmierczak et al., 2025). In addition, AI-supported systems can provide individualized learning support by responding to students' inputs dynamically and offering immediate corrective feedback during problem-solving activities (Tan et al., 2025; Kasneci et al., 2023). These learning environments not only facilitate conceptual understanding but also encourage active participation and sustained engagement during the learning process (Makranski & Petersen, 2021; Kaźmierczak et al., 2025).

Although research on AI integration in education has grown rapidly, many existing studies continue to focus primarily on learning outcomes rather than students' perceptions and learning experiences (Zawacki-Richter et al., 2019). In fact, students' perceptions are important because they influence acceptance, engagement, and the intention to continue using educational technology (Li et al., 2025). Perceived usefulness and perceived ease of use are considered important determinants of technology acceptance and sustained interaction with digital learning systems (Alshammari & Alkhwaldi, 2025; Li et al., 2025). Moreover, examining students' perceptions may provide valuable insights into

whether a learning application effectively supports conceptual understanding, motivation, and usability during the learning process (Kasneci et al., 2023; Makranski & Petersen, 2021).

Therefore, this study aims to examine university students' perceptions of an AI-assisted interactive application designed to support learning of Cartesian coordinates. The study focuses on three main aspects: conceptual understanding, learning motivation, and usability. By incorporating both cognitive dimensions, such as perceived usefulness, and affective dimensions, including enjoyment and trust, this study extends the Technology Acceptance Model (TAM) in order to better understand students' experiences in AI-supported learning environments (Li et al., 2025; Alshammari & Alkhwaldi, 2025). The findings are expected to contribute to the growing discussion on artificial intelligence in mathematics education and provide practical insights into the design of interactive learning applications that support students' conceptual understanding and engagement.

Review of Related Literature

The literature on mathematics education and digital learning technologies reveals a strong emphasis on addressing conceptual difficulties while leveraging innovative tools. Foundational challenges in topics such as the Cartesian coordinate system persist, with students often misinterpreting ordered pairs and quadrants (Guven, 2022; Maryanto et al., 2022). These difficulties are closely tied to spatial ability, which plays a critical role in problem representation and reasoning (Duffy et al., 2024; Li et al., 2026).

Digital interventions have been widely explored to mitigate such issues. Studies highlight the effectiveness of adaptive e-learning systems and interactive feedback in improving engagement and conceptual understanding (Awang et al., 2024; Barana et al., 2021). Augmented and immersive technologies, such as augmented reality and virtual reality, further enhance visualization and reasoning (Kaźmierczak et al., 2025; Makransky & Petersen, 2021). Student satisfaction and usability remain central to sustaining the use of digital platforms (Sahraini et al., 2024; Li et al., 2025).

The integration of artificial intelligence into mathematics education is rapidly expanding. AI-based systems like CalcTutor provide generative feedback for calculus problem solving (Tan et al., 2025), while context-aware AI supports instructors in large classes (Barghorn et al., 2026). Broader analyses of large language models (Kasneci et al., 2023; Miskei-Váradi et al., 2025) highlight both opportunities and challenges, stressing the need for pedagogical grounding (Zawacki-Richter et al., 2019; OECD, 2021).

Overall, the literature suggests that combining diagnostic insights into student misconceptions with AI-assisted, interactive digital interventions offers a promising pathway to strengthen mathematical reasoning, enhance conceptual understanding, and ensure sustainable use of digital learning technologies (Alshammari & Alkhwaldi, 2025; Sofroniou et al., 2025; Sultana, 2025).

Objectives

The objectives of the article are to examine university students' perceptions of an AI-assisted interactive application designed to support learning of Cartesian coordinates. Specifically, the study aims to identify conceptual difficulties such as interpreting ordered pairs, connecting symbolic and spatial representations, and overcoming reliance on

procedural approaches. It seeks to investigate the role of spatial reasoning in students' ability to construct accurate mental models of mathematical problems. Another objective is to evaluate the effectiveness of interactive visualization and AI-supported feedback in enhancing conceptual understanding, motivation, and usability.

The study also intends to extend the Technology Acceptance Model by incorporating both cognitive dimensions, such as perceived usefulness, and affective dimensions, including enjoyment and trust, to better understand students' experiences in AI-supported environments. It aims to assess learning motivation fostered by interactive applications and to analyse usability factors that influence sustained engagement. By focusing on students' perceptions, the research seeks to determine acceptance and continued use of AI-assisted learning systems. Ultimately, the objectives are to contribute to mathematics education by providing practical insights into the design of digital learning applications that integrate visualization, adaptive feedback, and personalized support, thereby strengthening conceptual understanding, spatial reasoning, and active participation in mathematics learning.

Methodology

Research Design

This study employed a quantitative descriptive research design to examine university students' perceptions of an AI-assisted interactive application for learning Cartesian coordinates. The study focused on describing students' responses after interacting with the application, particularly regarding conceptual understanding, learning motivation, and usability. A descriptive approach was considered appropriate because the study aimed to identify general trends in students' perceptions rather than to investigate causal relationships or compare instructional treatments (Romero Naranjo et al., 2023; Sahraini et al., 2024).

Participants and Research Context

The study was conducted at a private university in Indonesia where students are required to take mathematics-related courses as part of their academic program. The participants consisted of 75 undergraduate students enrolled in mathematics-related courses in three different classes. Most participants had previously studied Cartesian coordinate concepts during secondary education; however, preliminary observations indicated that many students still experienced difficulties in interpreting coordinate representations and connecting symbolic coordinates with spatial positions on the coordinate plane.

Participants were selected using a convenience sampling technique based on their accessibility and involvement in the learning activity (Adeoye, 2023). Although convenience sampling has limitations regarding generalizability, it is commonly used in educational research to obtain data from readily available participants within a specific learning context (Dauda et al., 2016).

AI-Assisted Interactive Learning Application

The learning media used in this study was an AI-assisted interactive application designed to support students' understanding of Cartesian coordinates through visualization, immediate feedback, and guided exploration activities. The application combines interactive coordinate visualization with intelligent feedback features that assist students during learning activities.

The main features of the application include:

1. Interactive Visualization

Students can plot and manipulate points directly on the Cartesian plane to observe the relationship between coordinate values and spatial positions.

2. Dynamic Feedback
   The system provides immediate corrective responses when students input incorrect coordinates or identify incorrect quadrants.
3. AI-Assisted Guidance
   The application offers adaptive hints and explanatory guidance based on students' responses during learning activities. These AI-assisted prompts are intended to support conceptual understanding and reduce repeated misconceptions during practice sessions.
4. Exploratory Learning Activities
   Students complete guided activities that encourage active exploration of coordinate concepts through repeated interaction and visual experimentation.

The AI component in this application functions primarily as an intelligent feedback and guidance system rather than as a fully autonomous artificial intelligence environment. The system analyses students' responses and generates contextual hints and corrective feedback to support learning activities in real time.

Research Instruments

1. Conceptual Understanding
   This aspect measured students' perceptions regarding how the application supported their understanding of Cartesian coordinate concepts, including identifying points, determining quadrants, and interpreting coordinate representations.
2. Learning Motivation
   This aspect examined students' interest, engagement, confidence, and willingness to continue learning using the application.
3. Usability
   This aspect evaluated students' perceptions regarding the ease of use, clarity of instructions, and visual design of the application.

The questionnaire items were developed based on previous studies related to technology-assisted mathematics learning and technology acceptance in education. Prior to implementation, experts in mathematics education and educational technology to ensure content validity and clarity of the questionnaire items reviewed the instrument. The reliability analysis showed that the instrument achieved an acceptable Cronbach's alpha coefficient, indicating good internal consistency.

Data Collection Procedure

Data collection was conducted during a guided classroom learning session. At the beginning of the session, students were introduced to the features and functions of the AI-assisted application. Students then interacted individually with the application while completing a series of coordinate-related learning activities and exercises.

During the learning process, students explored coordinate concepts through interactive visualization activities and received immediate feedback and AI-assisted guidance from the system. After completing the learning session, students were asked to complete the perception questionnaire based on their learning experiences while using the application.

Participation in this study was voluntary, and all collected responses were analysed anonymously for research purposes.

Analysis

Data Analysis

The collected data were analysed using descriptive statistical techniques to identify patterns in students' perceptions regarding the application. The analysis included the calculation of mean scores and standard deviations for each questionnaire item and each learning aspect. To interpret students' perception levels, the following criteria were used Table 1:

Table 1. Criteria Levels

Mean Score Range	Interpretation
1.00–1.75	Low
1.76–2.50	Moderate
2.51–3.25	High
3.26–4.00	Very High

The results were then aggregated to obtain an overall representation of students' perceptions regarding conceptual understanding, learning motivation, and usability of the AI-assisted interactive application. Data analysis was conducted using statistical software to ensure accuracy and consistency of the calculations.

Findings and Discussion

Overview of Student Responses

A total of 75 responses were collected from students from three classes (A, B, and C). The questionnaire consisted of 14 closed-ended items measured using a 4-point Likert scale, as well as one open-ended question regarding ongoing difficulties.

Overall, the results indicate that students expressed positive perceptions toward the AI-assisted interactive Cartesian coordinate application. Most responses were concentrated at scale points 3 (agree) and 4 (strongly agree), suggesting a high level of acceptance across all measured aspects.

Descriptive Analysis of Questionnaire Items

To examine students' perceptions in more detail, descriptive statistics were calculated for each questionnaire item. The results are summarized in Table 2.

Table 2. Mean Scores of Students' Perceptions (n = 75)

No	Item Description	Mean	Category
1	Understanding of determining coordinate points (x, y)	3.32	High
2	Understanding of abscissa (x) and ordinate (y)	3.30	High
3	Understanding of determining quadrants	3.28	High
4	Ability to read points from coordinate graphs	3.29	High
5	Understanding of procedural steps in determining coordinates	3.31	High
6	Confidence in determining coordinate points	3.25	High
7	Reduced fear of making mistakes	3.22	High
8	Willingness to retry after errors	3.36	High

9	Enjoyment in learning using the application	3.41	High
10	Increased motivation in learning	3.39	High
11	Interest in repeating practice	3.34	High
12	Ease of use of the application	3.45	High
13	Clarity of instructions	3.38	High
14	Visual representation supports understanding	3.47	High
Overall Mean		3.39	High

The overall mean score of 3.39 indicates a high level of agreement, confirming that students perceived the application positively. The highest mean scores were observed in items related to visual representation (Item 14) and ease of use (Item 12), suggesting that the interactive and visual features of the application played a significant role in supporting learning.

Perception Based on Learning Aspects

To provide a clearer interpretation, the questionnaire items were grouped into three aspects: conceptual understanding (Items 1–6), learning motivation (Items 7–11), and usability (Items 12–14). The results are presented in Table 3.

Table 3. Mean Scores by Learning Aspect

Aspect	Items	Mean	Category
Conceptual Understanding	1–6	3.29	High
Learning Motivation	7–11	3.34	High
Usability	12–14	3.43	High

The results show that all three aspects fall within the “high” category. Among them, usability obtained the highest mean score, indicating that students found the application easy to use and well designed. Meanwhile, conceptual understanding also received strong agreement, suggesting that the application effectively supported students in grasping coordinate concepts.

Analysis of Open-Ended Responses

Students’ responses to the open-ended question revealed that most participants reported no significant difficulties after using the application. However, several recurring challenges were identified among a smaller number of students.

The most frequently reported difficulties include:

- Determining coordinate points based on given instructions
- Identifying correct values of x and y
- Determining the quadrant of a point
- Interpreting points from coordinate diagrams

Despite these challenges, many students indicated that repeated practice within the application helped them overcome initial misunderstandings.

The findings of this study indicate that the AI-assisted interactive Cartesian coordinate application was positively perceived by students across all measured aspects, including conceptual understanding, learning motivation, and usability. The overall mean score of 3.39 reflects a very high level of agreement, suggesting that the integration of interactive

visualization and AI-assisted feedback can effectively support mathematics learning at the university level. Rather than functioning merely as a digital practice tool, the application appeared to support students in connecting symbolic coordinate representations with spatial interpretation during learning activities. This finding is consistent with previous research showing that digital technologies, including visualization tools and AI-supported systems, can enhance conceptual understanding and student engagement in mathematics learning (Sofroniou et al., 2025; Sultana, 2025). Interactive and adaptive learning features have also been shown to promote deeper learning by allowing students to explore mathematical concepts at their own pace while receiving immediate feedback during problem-solving activities (Barana et al., 2021; Awang et al., 2024). Furthermore, the findings align with studies suggesting that AI-assisted support can strengthen learning experiences when integrated within human-AI instructional workflows that combine automated feedback with teacher facilitation and pedagogical guidance (Barghorn et al., 2026).

From the perspective of conceptual understanding, students reported improved comprehension of coordinate concepts, including identifying points, distinguishing between abscissa and ordinate values, and determining quadrants. These findings suggest that the application successfully supported the transition from procedural manipulation toward conceptual and visual-spatial understanding. The combination of interactive visualization and AI-assisted feedback may have helped students construct stronger mental representations of coordinate relationships, which are essential for spatial reasoning development. This finding supports previous studies indicating that visualization-based learning environments help students move beyond rote memorization and develop deeper conceptual understanding of mathematical relationships (Sofroniou et al., 2025; Sultana, 2025). The relatively high mean scores across Items 1–6 also indicate that students were able to integrate procedural and conceptual knowledge simultaneously, reinforcing the argument that mathematical understanding becomes more meaningful when learners engage with multiple representations supporting spatial reasoning (Duffy et al., 2024; Barana et al., 2021). In addition, active geometry perception and interactive visual exploration have been shown to improve students' spatial reasoning performance and conceptual interpretation of mathematical objects (Li et al., 2026). Immediate feedback mechanisms within interactive learning environments may further strengthen students' ability to connect symbolic representations with visual-spatial meanings during coordinate interpretation activities (Awang et al., 2024; Sultana, 2025).

The findings also demonstrate the important role of AI-assisted feedback in supporting students' learning processes. The AI-supported guidance system provided immediate corrective responses and explanatory prompts when students made errors during coordinate activities. Such scaffolding may have contributed to reducing repeated misconceptions related to coordinate positioning and quadrant identification. Rather than simply informing students whether answers were correct or incorrect, the feedback mechanism encouraged students to revisit their reasoning and refine their understanding through repeated interaction. This finding supports the view that AI-assisted learning systems can function as cognitive scaffolding tools that facilitate conceptual refinement and self-correction during mathematics learning activities (Kasneci et al., 2023). The integration of immediate feedback and guided exploration may therefore play an important role in supporting students' mathematical reasoning processes, particularly in topics involving spatial interpretation and symbolic representation.

The results further highlight the application's contribution to students' learning motivation and engagement. Items related to enjoyment, willingness to retry, and increased enthusiasm (Items 7–11) received consistently high ratings, suggesting that the application created a learning environment that encouraged persistence and reduced anxiety when making mistakes. These findings are important because mathematics learning is often associated with low confidence and fear of failure, particularly when students encounter abstract and visually demanding concepts (Miskei-Váradi et al., 2025). The interactive and exploratory nature of the application appeared to support a more positive affective learning experience by allowing students to experiment with coordinate manipulation and receive feedback without fear of immediate judgment. This finding is consistent with previous studies indicating that interactive digital environments can reduce stress and maintain students' engagement during mathematics learning activities (Shikine et al., 2017; Barana et al., 2021). Similarly, technology-enhanced learning environments integrating digital interaction and visualization have been found to positively influence students' motivation and participation in mathematics learning (Fraca et al., 2019).

In terms of usability, the application obtained the highest mean score among all measured aspects. Students perceived the application as easy to use, visually clear, and supportive for understanding coordinate concepts. This finding suggests that the application successfully minimized unnecessary interface complexity, allowing students to focus more on conceptual reasoning rather than on navigating the system. The high usability ratings also indicate that perceived ease of use played an important role in shaping students' positive learning experiences, which aligns with the Technology Acceptance Model emphasizing usability and usefulness as important determinants of technology acceptance (Alshammari & Alkhwaldi, 2025; Li et al., 2025). Previous studies similarly emphasize that user-friendly interface design and interactive visualization features significantly influence students' engagement and satisfaction with digital learning platforms (Awang et al., 2024; Barana et al., 2021). In addition, effective graphical representations may help reduce cognitive load and support the development of more accurate mental models of mathematical relationships (Sofroniou et al., 2025).

Despite the overall positive findings, the analysis of open-ended responses revealed that several students still experienced difficulties in distinguishing between x- and y-values, determining quadrants, and interpreting graphical representations. This finding indicates that interactive visualization alone may not fully eliminate deeply rooted misconceptions related to coordinate interpretation. Similar difficulties have been reported in previous studies showing that students often struggle to understand coordinate axes as reference systems and frequently confuse x- and y-values during problem-solving activities (Maryanto et al., 2022). Guven (2022) also found that many students interpret coordinates merely as labels rather than as directed distances from the origin. These persistent difficulties suggest that some learners may still require additional scaffolding and guided instruction during conceptual learning activities. Differences in prior knowledge and spatial reasoning ability may further influence how effectively students interpret coordinate relationships, since spatial ability plays an important role in constructing accurate mental representations (Duffy et al., 2024). Moreover, Barghorn et al. (2026) reported that although students valued AI-generated responses for their immediacy and relevance, they still relied on instructor verification to strengthen trust and confidence in the learning process.

Importantly, the presence of these difficulties should not necessarily be interpreted as a limitation of the application itself, but rather as evidence that conceptual understanding develops gradually through iterative learning processes. Students who initially struggled with coordinate interpretation were able to engage in repeated practice and receive immediate feedback during learning activities, which may have contributed to gradual conceptual refinement over time. This finding reinforces the importance of repetition, feedback, and guided exploration in mathematics learning environments. Previous studies have similarly demonstrated that repeated interaction combined with immediate corrective feedback can help students identify misconceptions, refine reasoning processes, and improve conceptual understanding progressively (Barana et al., 2021; Sultana, 2025). Interactive digital learning environments that allow students to revisit errors and retry problem-solving activities therefore provide meaningful opportunities for conceptual growth and self-regulated learning (Shikine et al., 2017).

Overall, the findings suggest that AI-assisted interactive learning applications have strong potential to support mathematics learning, particularly in topics requiring the integration of symbolic representation, visualization, and spatial reasoning. The combination of interactive visualization, immediate feedback, and AI-assisted guidance appears to support both cognitive and affective aspects of learning by helping students develop conceptual understanding while simultaneously maintaining engagement and motivation. Nevertheless, future development of similar applications may benefit from incorporating more adaptive scaffolding mechanisms capable of providing differentiated support based on students' individual learning needs and spatial reasoning abilities.

Conclusion

This study examined university students' perceptions of an AI-assisted interactive application designed to support learning of Cartesian coordinates. The findings indicate that the application was positively perceived across the aspects of conceptual understanding, learning motivation, and usability, with an overall mean score of 3.39. These results suggest that the integration of interactive visualization and AI-assisted feedback can provide meaningful support for mathematics learning, particularly in topics involving symbolic representation and spatial interpretation. From a cognitive perspective, the application appeared to support students in connecting coordinate symbols with visual-spatial representations more effectively. The combination of interactive exploration, immediate feedback, and AI-assisted guidance helped students strengthen their understanding of coordinate relationships, point positioning, and quadrant interpretation. The findings further suggest that AI-supported scaffolding may play an important role in helping students refine conceptual understanding through repeated practice and corrective feedback during learning activities.

In addition to supporting conceptual learning, the application also contributed positively to students' motivation and engagement. Students reported greater enthusiasm, confidence, and willingness to retry after making mistakes, indicating that the interactive learning environment encouraged more active participation and reduced anxiety during mathematics learning. The high usability ratings further demonstrate that a clear interface design and effective visual representation are important factors in supporting positive learning experiences and sustained interaction with digital learning systems. Overall, this study highlights the potential of AI-assisted interactive learning applications to support conceptual reasoning, spatial understanding, and engagement in mathematics education. Rather than functioning solely as digital practice tools, AI-assisted systems may serve as

cognitive support environments that facilitate conceptual refinement through visualization, feedback, and guided exploration. These findings contribute to the growing discussion on artificial intelligence in mathematics education, particularly regarding the role of AI-assisted scaffolding in supporting visual-spatial learning processes.

Nevertheless, this study has several limitations that should be considered. The research focused primarily on students' perceptions during a single learning session and employed a descriptive design without comparison to other instructional approaches. Future studies may therefore investigate the long-term effects of AI-assisted learning applications on conceptual retention, mathematical reasoning, and transfer of learning. Further research could also explore how individual learner characteristics, such as spatial reasoning ability and prior mathematical knowledge, influence students' interactions with AI-supported learning environments. In addition, future application development may benefit from integrating more adaptive and personalized feedback systems capable of providing differentiated support based on students' learning needs and interaction patterns.

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Contextual Effectiveness of AI vs Human Teaching: A Conditional Analysis of Learning Outcomes

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Abstract

The growing use of artificial intelligence in education has raised important questions about its effectiveness compared to traditional teaching methods. Many studies present this comparison as a simple choice between the two but often ignore the different situations in which learning takes place. This paper explores how AI-based learning and human teaching perform across various contexts. It focuses on understanding of concepts, development of skills, critical thinking, and long-term retention.The analysis shows that AI systems are effective in providing personalized learning, quick feedback, and support for skill-based tasks. At the same time, traditional teaching remains important for developing deeper thinking, discussion, and social interaction. These findings suggest that no single method is always better. Instead, the success of each approach depends on how well it fits the learning situation.The study also highlights limitations of both methods, including overdependence on technology in AI learning and limited individual attention in traditional classrooms. To address these issues, a combined approach is suggested. This hybrid model brings together strengths of AI and human teaching to create a balanced learning experience. The paper concludes that effective education should focus on proper integration of both methods to improve overall learning outcomes.Further research and practical application are necessary to understand how this integration can be effectively implemented in different educational environments. Consideration of student needs, teacher roles, and institutional support will be essential in shaping future learning systems that are both flexible and meaningful for learners across diverse disciplines and levels of education globally.

Keywords: Artificial Intelligence, Educational Effectiveness, Hybrid Learning, Learning Outcomes, Traditional Teaching

Introduction

Education has undergone a major transformation with the rapid advancement of artificial intelligence. AI tools have become an integral part of modern learning environments, influencing how students access, process, and apply knowledge. These technologies provide personalized learning, immediate feedback, and flexible access to educational resources.

However, this shift has raised concerns regarding the effectiveness of AI compared to traditional teaching methods. While AI enhances efficiency and accessibility, traditional teaching continues to provide emotional support, interaction, and guided learning. These contrasting features create a need to evaluate both methods critically.

Rather than treating this as a simple comparison, this study focuses on understanding the contexts in which each method performs effectively. Learning varies across situations, and different methods serve different purposes. This research aims to analyse how AI and traditional teaching impact learning outcomes and to propose a balanced approach.

Review of Related Literature

Artificial intelligence in education has been widely studied for its ability to personalize learning. According to Holmes et al. (2019), AI enables adaptive learning environments that improve student performance. However, studies also indicate that excessive reliance on AI reduces independent thinking.

Traditional teaching, as discussed by Dewey (1938), focuses on experiential learning and interaction. It plays a key role in developing critical thinking and communication skills. Recent research suggests that hybrid learning models combining AI and human teaching provide better outcomes by balancing efficiency and understanding.

Objectives

The increasing dependence on AI in education has created uncertainty regarding the effectiveness of traditional teaching methods and their relevance in modern learning environments.

- To analyse AI-based learning effectiveness
- To evaluate traditional teaching
- To compare both methods
- To study student dependency on AI
- To propose a hybrid model

Methodology

This study uses a cross-sectional survey design involving 100–150 students. Data was collected using structured questionnaires based on:

- AI usage frequency
- Thinking independence
- Conceptual understanding
- Task completion speed

Participants were grouped into:

- High AI Users
- Moderate Users
- Low Users

A comparative analysis was used to evaluate learning outcomes.

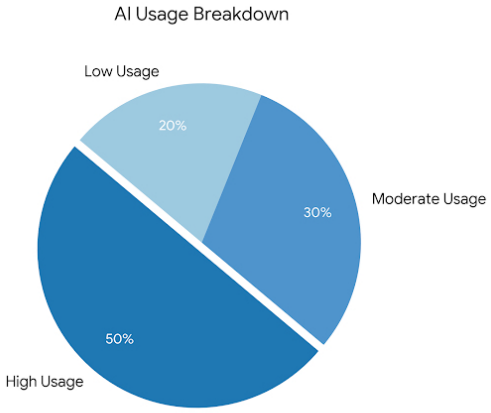
Findings and Discussion

AI Usage Distribution

The collected data shows:

- 50% high AI usage
- 30% moderate usage
- 20% low usage.

This indicates that AI has become a primary learning tool rather than a supportive one.

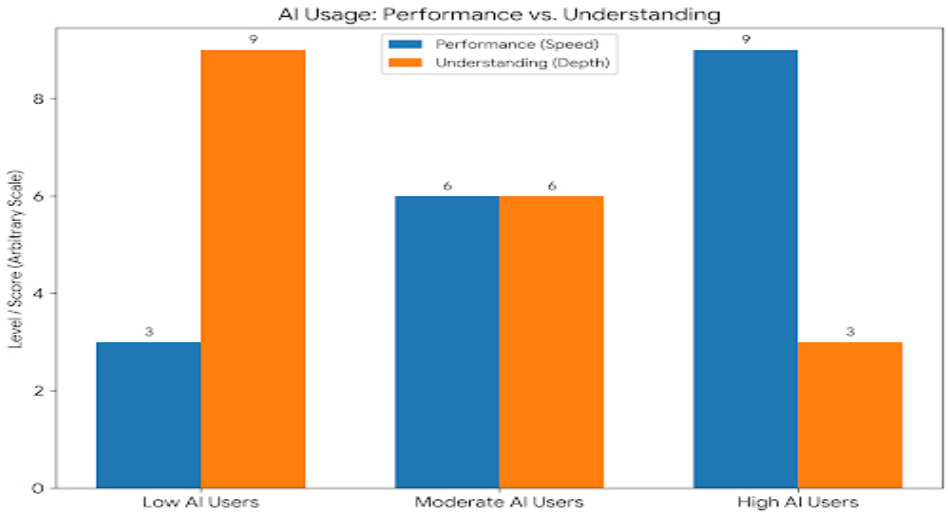


4.2 Performance Analysis

Category	High AI	Moderate	Low AI
Thinking Share (%)	20	40	90
Logic Score	0.3	1.2	4.8
Task Speed (min)	5	25	85

Interpretation

- High AI users show fast performance but low understanding
- Low AI users show slow performance but deep understanding
- Moderate users maintain a balance



Key Insight
This creates a paradox:
Efficiency increases, but cognitive depth decreases

This proves that:

- AI supports productivity
- But weakens independent thinking

AI-based learning is effective for:

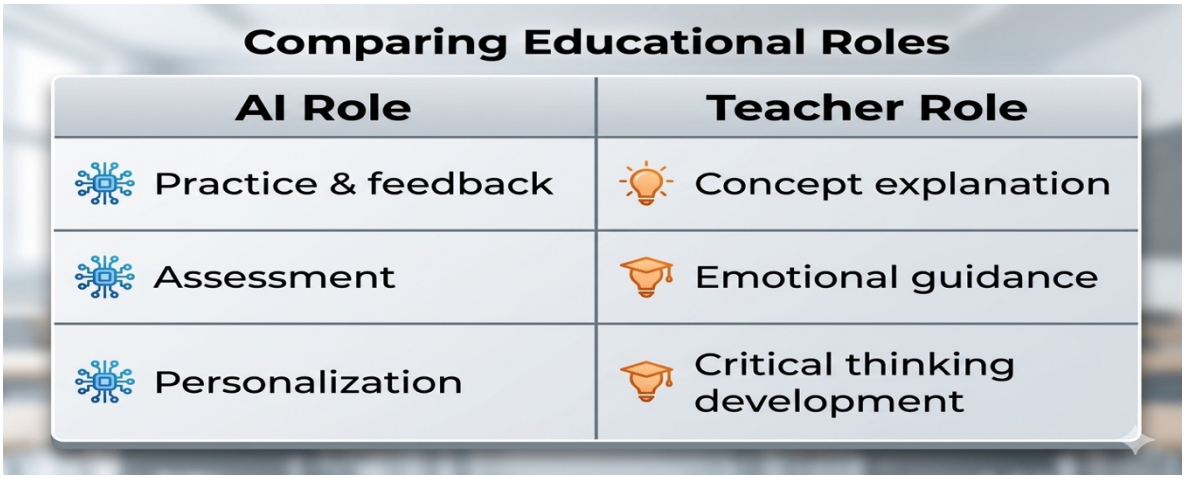
- Skill training
- Quick problem-solving
- Repetitive practice

Traditional teaching is effective for:

- Critical thinking
- Concept clarity
- Emotional and social learning

The study shows that neither method alone is sufficient. Learning effectiveness depends on context.

Hybrid Learning Model
A combined approach is proposed:



Summary of Findings
This study examined the effectiveness of artificial intelligence and traditional teaching across different learning contexts. The findings show that AI is highly effective in providing personalized learning, quick feedback, and improving performance in skill-based tasks. However, increased reliance on AI may reduce independent thinking and lead to superficial understanding.

In contrast, traditional teaching remains essential for developing critical thinking, conceptual clarity, and social interaction. Teachers play a key role in guiding students and encouraging deeper engagement with learning. The study highlights that effectiveness depends on the learning context rather than the superiority of one method over the other.

Conclusion

The study concludes that artificial intelligence and traditional teaching should not be viewed as competing approaches but as complementary systems. AI offers efficiency and accessibility, while traditional teaching provides depth and human connection.

A hybrid learning model that combines both methods is the most effective solution. By integrating AI tools with teacher-led instruction, education can become both efficient and meaningful. The future of learning depends on maintaining a balance between technological advancement and human-centered teaching.

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The AI Detector Paradox: A PLS-SEM Analysis of Detection Bias in Chinese L2 Undergraduate Writing

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Abstract

This study investigates the "AI Detector Paradox"—algorithmic bias against L2 English writers. Using Partial Least Squares Structural Equation Modeling (PLS-SEM) on a baseline corpus of 200 verified human-authored undergraduate theses, we analyzed how specific lexical features affect ZeroGPT false-positive rates. Results reveal a counterintuitive "Penalty of Proficiency." Formulaic language reliance does not trigger misclassification. Instead, higher lexical diversity (TTR) significantly increases the risk of AI misclassification ($\beta = 0.188$, $p < 0.01$), whereas dense academic vocabulary (AWL) paradoxically serves as a protective shield ($\beta = -0.284$, $p < 0.001$). These findings empirically demonstrate that current AI detectors mechanically penalize L2 linguistic maturation, inadvertently coercing international students to revert to rigid, template-based writing to avoid false accusations.

Keywords: Academic Integrity, AI Detection Bias, Formulaic Language, L2 Learners, PLS-SEM

Introduction

The application of large language models (LLMs), such as ChatGPT, Gemini, and Claude, in academic writing has increased exponentially in recent years. To counteract this irreversible trend, various AI detectors, such as GPTZero, Turnitin, Quillbot, and ZeroGPT, have been extensively employed by higher education institutions to defend academic integrity (Yan et al., 2023). Nevertheless, a growing body of recent empirical studies has revealed that these algorithms are overly dependent on statistical probability indicators (namely, perplexity and burstiness), resulting in inaccurate AIGC probability scores and even leading to the devastating misclassification of human-written texts as AI-generated content when assessing advanced writing (Elkhatat et al., 2023; Walters, 2023). Consequently, to avoid false accusations of plagiarism against students and the hegemony of a single AI detector, scholars have resorted to a makeshift solution of aggregating the results of multiple AI detectors to lower the risk of being misflagged (Hyatt et al., 2025).

A broader spectrum of interest in this field focuses on the specific groups disproportionately affected by this algorithmic incompetence. A pioneering study conducted by Liang et al. (2023) demonstrated that currently available AI detectors pose a systemic bias against texts written by Non-Native English Speakers (NNES), while Alexander et al. (2023) resonated with this point and went further into the failing of AI benchmarks in assessing ESL or EFL writing in interdisciplinary research. As supporting evidence, Ibrahim (2023) investigated an ESL database, which reinforced that there exists

strong inconsistency and vulnerability when AI classifiers scan ESL texts. Concerning L2 learners' language competence, they are more prone to choose words in a more conservative way and use highly structured syntax, increasing the likelihood of triggering the detector's "low information entropy" red lines. To some extent, this algorithmic flaw is mechanically driving the academic marginalization and stigmatization of L2 learners.

Despite these empirical studies, current research leaves a critical empirical gap: major scholars still regard L2 writing features as an ambiguous monolithic entity, taking it superficially as a dichotomous question varying from AI tools. Rarely does any study adopt a corpus linguistics perspective to measure which specific linguistic features in L2 English writing independently trigger algorithmic false positives through the application of Structural Equation Modeling (SEM). To bridge the research gap, this study constructs a "Zero-AI L2 English human-written corpus", encompassing undergraduate theses, and integrates the Partial Least Squares Structural Equation Model (PLS-SEM). This approach is designed to control all latent variables and precisely quantify how individual linguistic features independently affect AIGC probability scores. To achieve the precise extraction of L2 linguistic features, this study draws upon the Academic Word List (AWL) and the University of Manchester's Academic Phrasebank to formulate the following three directional structural path hypotheses for empirical testing:

- **H1 (Formulaic Language Reliance):** Formulaic language reliance, measured by the frequency of 4-word bundles, positively predicts the AI misclassification rate.
- **H2 (Lexical Formality):** Lexical formality, measured by academic vocabulary density (AWL%), positively predicts the AI misclassification rate.
- **H3 (Lexical Diversity):** Lexical diversity, quantified by the Type-Token Ratio (TTR%), positively predicts the AI misclassification rate.

Review of Related Literature

The integration of artificial intelligence (AI) in education has introduced both opportunities and challenges in assessing student writing. AI detection tools aim to distinguish human-authored from AI-generated text, but their performance varies. Elkhatat, Elsaid, and Almeer (2023) highlighted inconsistencies in detection accuracy, while Walters (2023) found significant differences among 16 popular AI detectors. Hyatt et al. (2025) suggested aggregating multiple detector outputs to reduce false positives, noting that reliance on a single tool risks misclassifying human writing. DetectGPT, proposed by Mitchell et al. (2023), uses probability curvature for zero-shot detection, offering advanced approaches but still facing limitations across diverse writers.

A growing concern is detection bias. Liang et al. (2023) demonstrated that GPT detectors often misclassify non-native English writers' text as AI-generated. Pratama (2025) examined the trade-off between detection accuracy and fairness, emphasizing that strict detection can disadvantage non-native writers. Alexander, Savvidou, and Alexander (2023) and Ibrahim (2023) similarly highlighted risks for ESL students, where AI-based detectors may unfairly flag legitimate work. Weber-Wulff et al. (2023) confirmed inconsistencies in multiple detection tools, further illustrating the "AI detector paradox"—tools intended to ensure integrity can penalize L2 writers.

From a linguistic perspective, L2 writing features influence detection outcomes. Maamuujav (2021) noted that lexical choice and academic vocabulary shape L2 writing style, potentially triggering false positives. Yan, Fauss, Hao, and Cui (2023) found that

subtle stylistic differences in essays often lead AI detectors to misclassify student work. These studies indicate that current AI detection tools may inadequately account for L2 characteristics, leading to bias and unfair outcomes in assessment contexts.

Despite these insights, research using quantitative frameworks such as Partial Least Squares Structural Equation Modeling (PLS-SEM) to systematically examine detection bias in Chinese L2 undergraduate writing remains limited. Investigating the relationships between writing proficiency, AI detector outputs, and bias indicators through PLS-SEM can provide empirical evidence to refine detection algorithms and inform fairer pedagogical practices.

In sum, while AI detectors serve a vital role in academic integrity, they paradoxically risk misclassifying non-native writers' work. Addressing this detection bias is essential to ensure fairness in higher education assessment.

Objectives

The primary objective of this study is to investigate the biases of AI detectors in evaluating Chinese L2 undergraduate writing. It aims to determine how specific linguistic features in human-written L2 English texts influence the probability of being misclassified as AI-generated content. The study seeks to construct a "Zero-AI L2 English human-written corpus" to provide a reliable dataset for analysis. It intends to measure formulaic language reliance, lexical formality, and lexical diversity as key predictors of AI misclassification. Using the Partial Least Squares Structural Equation Modeling (PLS-SEM), the study aims to quantify the independent effect of each linguistic feature on detection outcomes. Another objective is to address the gap in existing literature, which treats L2 writing as a monolithic variable rather than analyzing individual linguistic characteristics. The study also seeks to identify latent variables that may mediate or moderate the relationship between L2 features and AI misclassification. By examining the frequency of 4-word bundles, academic vocabulary density, and Type-Token Ratio, the research aims to test the proposed hypotheses (H1–H3). Additionally, the study aims to provide empirical evidence to inform fairer and more accurate AI detection practices for L2 learners. Ultimately, the study seeks to contribute to both applied linguistics and academic integrity research by clarifying how AI detectors may inadvertently marginalize non-native English writers.

Methodology

Corpus Construction

The corpus of this research comprises 200 English-major undergraduate theses (5000 words to 8000 words) selected through random sampling from Chinese National Paper Open Access Database. These manuscripts were originally submitted between 2018 and 2020, which is the critical period prior to public availability of off-the-shelf Generative AI models (e.g., ChatGPT, Gemini). Adopting these historical samples could establish an absolute "Zero-AI baseline" to ensure any AIGC probability score flagged by AI detectors, such as ZeroGPT, GPTZero, Quillbot, Turnitin, definitively a false positive. To guarantee analytical validity, irrelevant components, e.g., cover page, Chinese abstract, table of content, tables and figures, reference, and appendices, were systematically removed from original texts. Subsequently, files were converted to plain text (.txt) format for precise feature extraction via AntConc 4.3.

Analysis

Feature Extraction

This study employs AntConc 4.3 to analyze multi-level linguistic features. In order to meet the latent variable requirements of the Partial Least Squares Structural Equation Modelling (PLS-SEM), three linguistic factors were selected to measure the L2 leaners' formulaic language dependency and lexical profiles: 1. Formulaic Language: to extract 4-word lexical bundles with high frequency and quantify the frequency as normalized frequency per 10,000 words (Raw bundle count/Total token * 10,000); 2. Lexical Formality (Academic Word List, AWL): to calculate the density of academic vocabulary appeared in every sample (AWL token/Total token * 100%); 3. Lexical Diversity (Type-Token Ratio, TTR%): to measure lexical abundance and vocabulary variation per text (Type token/Total token * 100%).

Statistical Analysis

The overall weighted AIGC rate calculated by ZeroGPT was utilized as the final dependent variable in this study. To evaluate the hypothesized paths conceptualized in the PLS-SEM framework, all extracted linguistic independent variables underwent Z-score standardization, and multiple linear ordinary least squares (OLS) regression was employed to fit the structural paths. This methodological approach effectively controls for other potential confounding linguistic variables, thereby precisely isolating the independent explanatory power—quantified as the standardized path coefficient (β)—of each linguistic feature on AI detector bias.

Results and Discussion

Descriptive statistics

This study initially conducted a holistic descriptive analysis of the 200 Zero-AI baseline samples authored by Chinese L2 English learners (see Table 1). The statistics illustrate an average TTR of 23.69% (SD=2.51%). However, compared to the typical 30%-40% TTR threshold observed in proficient L1 academic writing (Maamuujav, 2021), this figure reflects a relatively restricted and conservative lexical diversity characteristic of undergraduate non-native writers. Moreover, the density of academic words (AWL%) averages 4.69% (SD=2.00%), which is indicative of a strong adherence to academic formality. The normalized frequency of 4-word bundles was recorded at an average of 62.58 per 10,000 words (SD=21.50). It is worth noting that despite conforming to absolute Zero-AI criteria, the corpus yielded an average AIGC misclassification rate of 7.16% (SD=5.19%), with the highest false-positive spike reaching 27.66%—a figure substantially higher than the stringent 20% threshold enforced by higher education institutions. In that, these descriptive findings provide valid empirical evidence that there is an undeniable and systematic false-positive bias among AI detectors against texts produced by L2 learners.

Table 1. Descriptive Statistics of Linguistic Features and AI Detection Bias (N = 200).

Variables	**M**	**SD**	**Min**	**Max**
Dependent Variable				
AI Detection Bias (ZeroGPT %)	7.16	5.19	0.00	27.66

Variables	M	SD	Min	Max
Independent Variables				
Formulaic Language (4-word bundles)	62.58	21.50	20.38	129.13
Lexical Formality (AWL %)	4.69	2.00	0.06	11.67
Lexical Diversity (TTR %)	23.69	2.51	16.77	32.90

Source: Author construct based on the corpus analysis

Correlation & Path Analysis

Table 2 below presents the Pearson correlation matrix for selected variables. All inter-construct coefficients (r) remain strictly between -0.40 and 0.40, well below the 0.70 threshold, thereby ruling out severe multicollinearity and establishing satisfactory discriminant validity. Crucially, these zero-order correlations, a positive link for TTR ($r = 0.20$, $p < 0.01$) alongside negative links for AWL ($r = -0.27$, $p < 0.01$) and Formulaic Language ($r = -0.21$, $p < 0.01$), perfectly preview the directional β pathways confirmed in the subsequent PLS-SEM analysis.

Table 2. Pearson Correlation Matrix of the Studied Variables

Variables	1	2	3	4
1. AI Detection Bias	1.000			
2. Formulaic Language	-0.21 **	1.000		
3. Lexical Formality (AWL)	-0.30 **	0.54 **	1.000	
4. Lexical Diversity (TTR)	0.20 **	-0.24 **	-0.04	1.000

Note: $p < 0.01$**. $N = 200$.

Based on the satisfactory discriminant validity established in Table 2, a PLS-SEM path analysis was executed. The overall structural model demonstrated high statistical significance ($F = 9.338$, $p < 0.001$).

The path testing results reveal a disruptive theoretical reversal (see figure 1). First, Hypothesis 1 (H1), which posited that formulaic language reliance increases AI detection rates, was not supported by the data ($\beta = -0.010$, $t = -0.122$, $p = 0.903$). **After controlling for other lexical variables, mere reliance on structural templates does not directly trigger algorithmic misclassification.** However, the model uncovered a profound "Penalty of Proficiency" effect regarding the remaining features:

1. Lexical diversity (TTR%) exerts a significant positive predictive effect on the AI misclassification rate ($\beta = 0.188$, $t = 2.729$, $p = 0.007$), supporting H3. **This empirically indicates that the more unique words and varied expressions a writer employs, the higher the risk of being algorithmically flagged as AI-generated.**

2. Conversely, academic vocabulary density (AWL%) serves as a highly significant negative protective factor against AI misclassification ($\beta = -0.284$, $t = -3.575$, $p < 0.001$), contradicting the hypothesized direction of H2. **The dense accumulation of formal academic vocabulary paradoxically functions as a digital shield, lowering the AI detection probability**

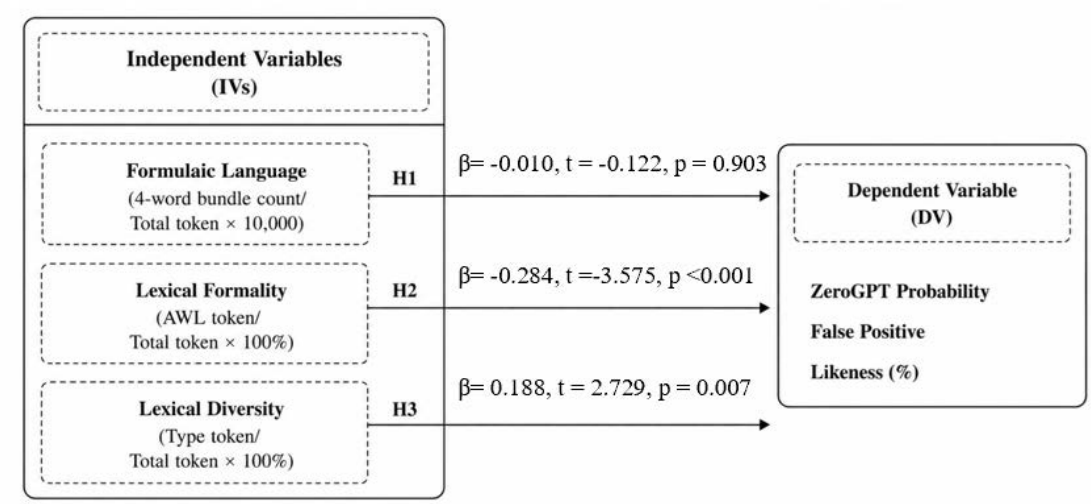

Figure 1. The Structural Model (PLS-SEM) Results

Conclusion

In conclusion, this research provides empirical evidence of a systematic false-positive bias inherent within widely adopted AI detectors. Beyond refuting the common misconception that formulaic 4-word bundles increase AI probability, this study demonstrates a paradoxical "Penalty of Proficiency." Specifically, while the dense accumulation of academic vocabulary serves as a protective shield, students' genuine developmental progress in lexical diversity (TTR) increases their risk of being misclassified as AI. These algorithmic flaws indicate that current AI detectors are not mature enough to accurately identify academic misconduct; instead, they mechanically penalize students' language growth. Accordingly, higher education institutions must critically assess the reliability and authority of these digital tools to prevent a pedagogical regression into rigid and formulaic writing practices.

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AI with AMI: A Key to Holistic Education

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Abstract

Education in the twenty-first century has transformed the teaching and learning experiences drastically. The advanced teaching and learning techniques with the use of AI has blurred the distinctions between the teacher and student as it used to be. Teachers are not only regarded as a person who explains the lessons from book but a person who teaches values, morals and mould them as humane citizens of the world. However, in the modern context, AI becomes the book, guide and philosopher for the students and thus there is a dire need for AI to be embedded with moral values. This research article titled "AI with AMI: A Key to Holistic education" will delve into how AI can be integrated with AMI that means Artificial Intelligence with Artificial Moral Intelligence to provide a holistic education that can make students empathetic rather than becoming mechanical or static. Artificial Moral Intelligence is the process of instilling moral values in the Artificial Intelligence machines. The research would analyse the existing AI apps used in Higher Education scenario and also its impact on the students. The paper would specifically probe into the apps or AI assistance that is available for learning resources and testing. A qualitative and quantitative analysis would be undertaken to establish the importance of incorporating AMI in AI for educational purpose.

Keywords: Artificial Intelligence, Artificial Moral Intelligence, Testing, Learning, Digital Learning

Introduction

Education in the twenty-first century has transformed the teaching and learning experiences drastically. The advanced teaching and learning techniques with the use of AI has blurred the distinctions between the teacher and student as it used to be. Teachers are not only regarded as a person who explains the lessons from book but a person who teaches values, morals and mould them as humane citizens of the world. The advancements in science and technology have replaced books with e-books, written tests with quizzes and games and live classrooms with digital classrooms. The teachers have become content creators, AI handlers and monitors. Smylie, Mark A. et.al in their article delineate the role of teachers from the 16th century onwards. They express that from the 16th century until the 18th century; schools focused on religious and moral development in the children. The mid- 18th century started to install scientific knowledge in the children. It also focused on politics and economics. The nineteenth century took a turn towards vocational and secular education. They also express that in the end of the 19th century and the 20th the teachers were expected to develop in the students “meaningful, civic, economic and intellectual life” (Smylie et al:2008). They also explain that teachers’ work has now become multi-dimensional in the twenty-first century.

Review of Related Literature

In the present educational scenario, technology has found its way in almost in all walks of life. So, it has become the duty of the teachers, whichever discipline it may be, to inculcate technological knowledge in the students to cope up with the job market. S. C. J. Lim et al., in the book Innovative Education Technologies for 21st Century Teaching and Learning expresses that "from the educational perspective, digital transformation is also required to equip students with the necessary digital skills and computational thinking to become next generation digital innovators" (S.C. J. Lim et al., 2021). They are also of the view that online education has a greater impact on the development of youth in the digital arena.

At the same time, Artificial Intelligence is considered unreliable and unethical as it draws data from all kinds of platforms and users. Th researchers also believe that most of the people use AI in a wrong way to manipulate data, morph and cheat others. Against such a background comes Artificial Moral Agents (AMA) to aid in creating machines more like an ideal being with neurology. Donghee Shin in his book expresses that "the approaches to identifying and designing artificial moral agents are based on several philosophical idea about morality." (Shin 2025). He also adds that in the process of creating AMAs, first ethics and code of conduct must be constructed and tested over machines with neurotechnology. The review of literature shows that AI has positively influenced teaching and learning processes through personalization, accessibility, and automation. However, most studies primarily focus on technological efficiency and academic performance, with limited attention to moral and ethical development. Existing research on AI ethics largely addresses issues of bias, privacy, and governance rather than the role of AI in nurturing humane values among students.

Asmat Ara Shaikh, et.al., in their article "The Role of Machine Learning and Artificial Intelligence for making a Digital Classroom and its sustainable Impact on Education during Covid-19" pinpoints the positive contribution of Artificial Intelligence in education during the Covid-19 pandemic. They opine that " While statistical methods and automated based on learning jobs that are smarter than normal continue to be important, learning is becoming more automated. It helps individuals to be more concentrated on their learning opportunities and to recognize when they do not grasp a subject completely" (Shaikh: 2022)

Forero-Corba and Bennasar, in their article "Techniques and applications of Machine Learning and Artificial Intelligence in education: a systematic review" express that "Continually, research in the education sector seeks to close educational gaps, and ML and AI emerge as an alternative means to achieve optimal results." They suggest that AI and Machine Learning (ML) would have a greater impact on the education of the students. Velentin Kuleto et.al., in their research article Exploring Opportunities and Challenges of Artificial Intelligence and Machine Learning in Higher Education Institutions" state that though it is good to integrate machine learning and AI with education, there are a lot of challenges in this make-shift. They express that "Despite teachers, researchers, managers, and students all facing perennial problems, new approaches to problems faced by these three groups are being developed with the assistance of AI and ML. First, the teaching workforce's quality should be improved to raise educational standards. Second, to achieve a higher standard of learning, it is critical to identify the factors contributing to teachers' workload. Third, teacher performance management is critical for effectively achieving the goals and objectives of high-quality educational standards. It is an ongoing

process for identifying, evaluating, and developing teacher performance." (Kuleto:2021). They are also of the view that due to the lack of funding and the constant inflation educational institutions couldn't manage the cost of building tech-friendly infrastructure and the cost of the apps.

Higher education institutions increasingly rely on AI-driven technologies for online learning, plagiarism detection, virtual mentoring, and automated evaluation. While these technologies improve efficiency, researchers argue that they cannot replace the emotional guidance and ethical mentorship provided by human teachers. Studies indicate that students using AI tools extensively may become passive recipients of information rather than active critical thinkers. Therefore, integrating AMI into educational AI systems can help promote reflective thinking, empathy, and ethical awareness. Researchers believe that morally informed AI can complement teachers by supporting students' cognitive as well as moral development.

Objectives

The review of literature thus shows that there is insufficient research examining how Artificial Moral Intelligence can be integrated into AI-based educational applications to support holistic education. The present study seeks to bridge this gap by analysing the importance of embedding AMI into AI systems used in higher education and evaluating its impact on students' emotional, ethical, and intellectual development.

Methodology

The present research article is foregrounded on a quantitative anlaysis of the two broader types of learning and testing, that is offline and online. A random sampling survey was conducted with 30 samples from B.A. English class, Fatima College, Madurai, Tamil Nadu, India. The survey was conducted at two phases. In the first phase, the students were asked to share their opinions about teaching and learning in the offline and online classes. Most of the students said that they liked the teaching and learning that happened in the offline classrooms. They responded that they were able to listen to the teacher in the physical classroom more attentively with less distractions. While in the online classrooms, they were unable to concentrate on the screen and they were not attentive to the monotonous voice and the same virtual materials, though colourful and readable with pictures and videos.

When they were asked about the testing during the offline and online mode, they replied that they preferred online tests as it is easy to write. They also added that in the physical classroom tests they couldn't cheat or look for answers anywhere, whereas in the online tests, they were able to look for the answers in another screen or window and easily score good marks. They also added that in most of the online tests had multiple choice questions, so it was easy for them to choose one.

Considering their responses and analysing, it was also found that due to constant exposure to online tests, that too multiple choice or short answers, the students later became reluctant to write long answers and essays. In order to get a more analytical information on the decline of moral standards in the use of AI for education and testing, various testing apps were analysed. Apps like quiziz, kahoot, testmarker, quizzing, trivia and Quizmaker, were taken into study and it was found that most of these apps have anti-cheat controls,

that doesn't allow the takers of the quiz to check for the answers in the quizzes, but this feature is paid.

Findings and Discussion

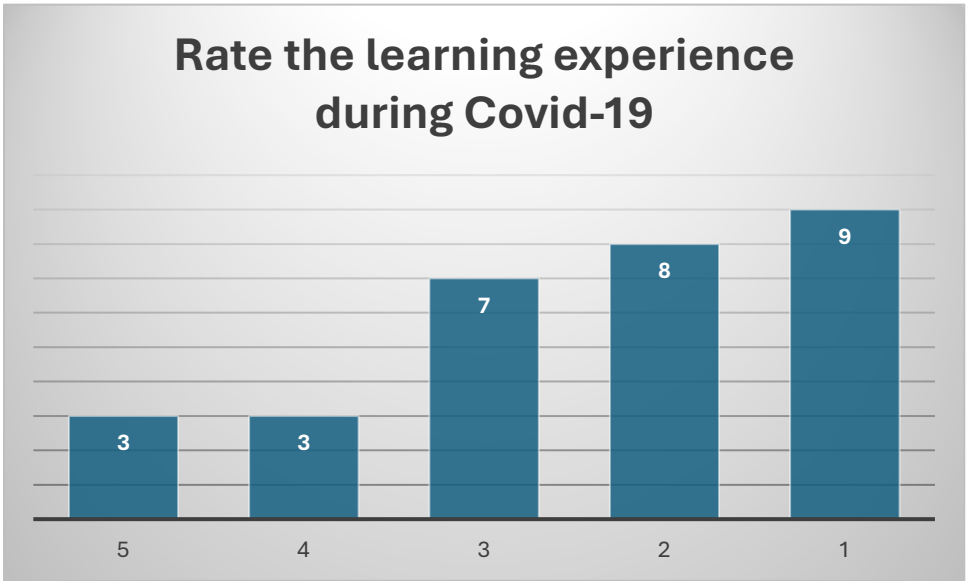

Figure 1: Rating of the learning experience during Covid-19 through online

The above chart shows that most of the students rated the online learning experience as not satisfactory, while a very few said that it was good. The rating ranged from 1 as the minimum and 5 as the maximum.

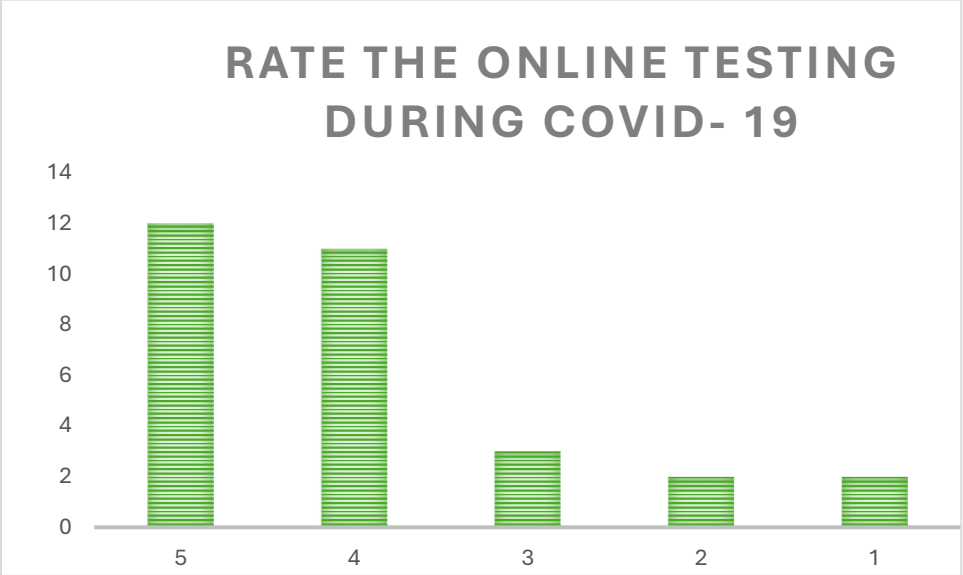

Figure 2: Rating of Online tests during Covid-19

Fig 2 reveals how much the students liked the online tests during covid-19. It shows that most of the students were highly satisfied with the online tests as it was easy and convenient for them. They also added that the online tests only took up a limited time and they liked it.

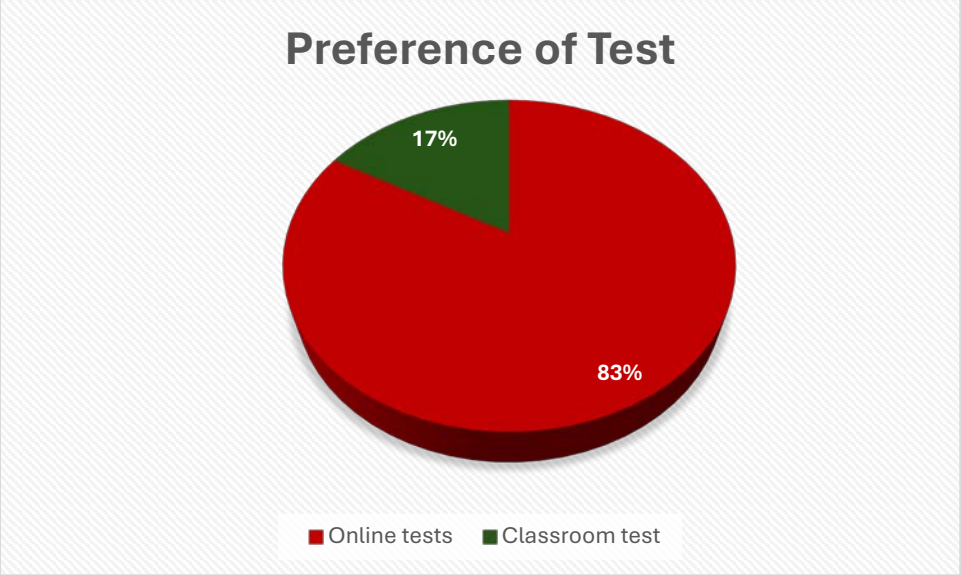

Figure 3: Students' preference of the mode of testing

The above figure shows that 25 students out of 30 expressed that they preferred online tests over the offline tests. This shows a sharp contrast between the earlier preference over online teaching and offline teaching. From this, it is inferred that the students are able to understand the teaching better in the physical classroom and they are able to feel the warmth of the human company. The contrast shows that the moral level of students is decreasing with the use of AI. This shows their mentality to choose shortcuts over the ethical standards of not to copy and be truthful. This makes the supposition of this research article that AI must have AMI by enabling the machines with Artificial Moral Agents that will not allow the students to diverge from the moral standards but make them more reliable citizens of the world.

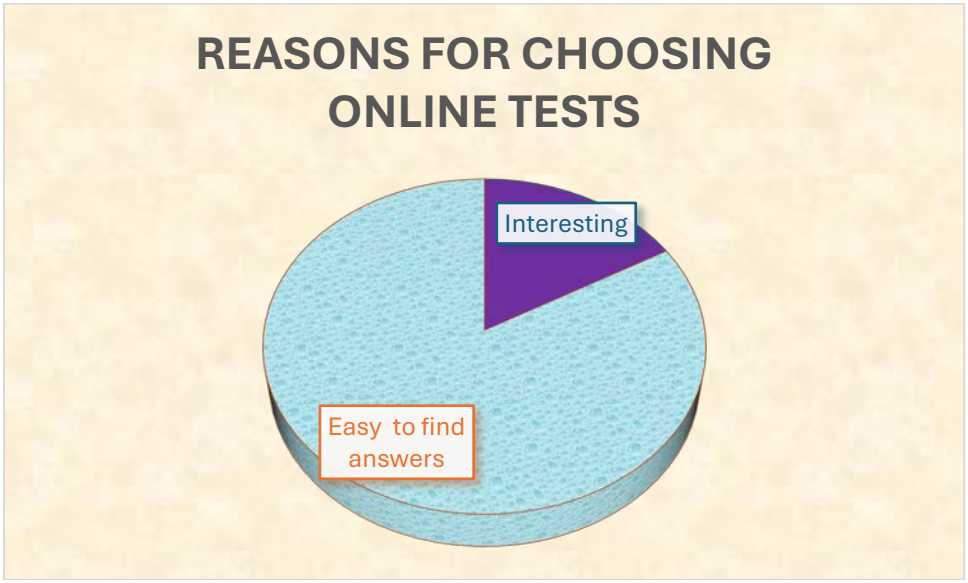

Figure 4: Reasons for choosing online tests over offline tests

Figure 4 correlates with the discussion of the previous question. It evidently shows that the students choose online tests not for being interesting like a game but for the convenience in just choosing answers instead of writing short or long answers and the

ease in locating or finding the correct answers with the help of other AI tools like ChatGPT, Perplexity, Meta, Google and so on. This also proves that students are not keen on developing or testing their knowledge but to get pass marks or full marks.

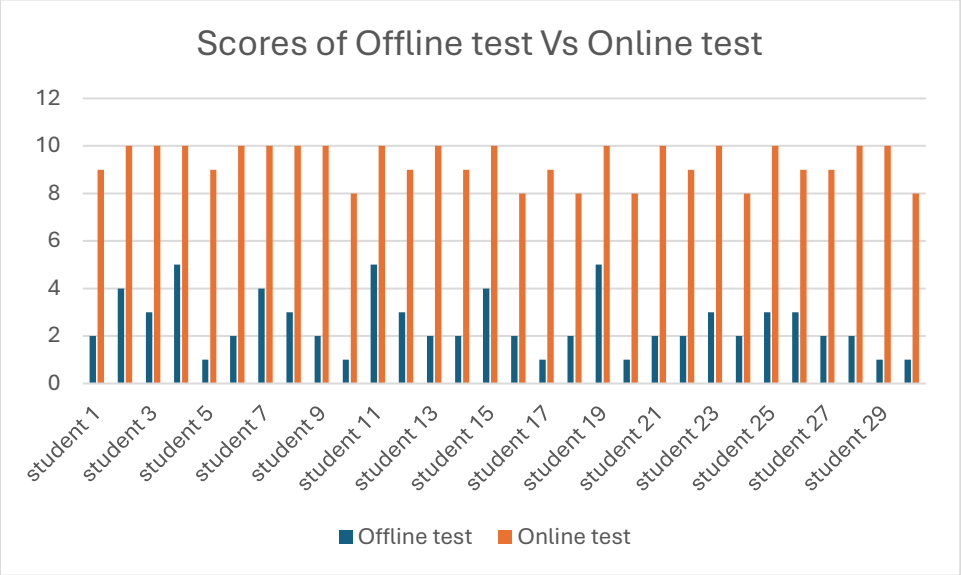

Figure 5: Scores of offline versus online tests

Finally after the sampling survey, the students were made to take up an offline and an online tests from a limited portion from their lesson. The tests were conducted to check the veracity of the previous survey conducted. In both the tests, 10 questions were given, out of the ten 8 questions remained the same. The results were shocking as the students scored high in the online test and in the offline tests, the scores were drastically low. Though the online testing was done with anti-cheat feature, the students were able to fish out the answers through some means to score high marks.

Conclusion

In the current scenario, AI is used in almost every field, commerce, finance, medicine and education. Though it is very much helpful in reducing labour for mankind, it is increasingly dangerous too. Wallach and Allen in their book state that "However, AI systems are increasingly required to develop their own values, to work out their own ethics, allowing them to make decisions as ethical subjects" (Wallach & Allen 2009). Though technology has developed and is developing in a very faster pace, there is always a lag in developing morally conscious machines using Artificial Moral Intelligence. Researchers in the field of AMI believe that this happens because of a glaring competition between the AI companies. There is huge discussion in the academia about holding AI systems responsible for the mishaps or degradation in quality and value system. Wynsberghe et al opine that the researchers also "…entertain the notion of artificial moral agents (AMAs) that can think and act morally and that might become essential if they turn out to be better thank humans in deliberations and acting morally". He also adds that they may also be able to adapt to the complexities of the contemporary societies in a better way than humans. Fanya Montalvo proposed the concept of AI Complete in the 1980s, that means creating an AI machine exactly like the humans with the same feelings, emotions and neurology. Unfortunately, though decades have passed still it's unimaginable to create such devices. Marsland is of the view that "To proceed, science needs to better understand what the difference between a feeling and a thought is. Feeling

pain and knowing about pain are certainly not the same internal states. I am hopeful that future research in this area will bring some long-awaited answers." (Marsland:2018). The research article thus makes it clear that if AI is instilled with Artificial Moral Agents, it can create more responsible teachers and students who can make the world a better place without any borders. Thus, this research article opens for discussions over keeping a fine balance between human teaching and AI teaching. It also suggests teachers to have a better hold on the students to teach them what, when, where, why and how and not to seek AI assistance. Thus, it is explicit that teachers' have to take up another role of being a moderator as well as a kind of consciousness of the students to discern the good and the bad for the sustenance of the world.

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Parents' Perspectives on the Use of Artificial Intelligence in Early Childhood Education Settings, Sri Lanka

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Abstract

The rapid development of Artificial Intelligence has had a significant impact on many industries, including education. AI-based applications are also being implemented in the ECE field to improve individual learning, interaction, and competence. Nevertheless, effective adoption of such technologies will be greatly determined by acceptance by the stakeholders especially parents. This paper examined parents' views on the introduction of AI in ECE classrooms in Sri Lanka, their awareness, perceived value, and the issues and determinants of acceptance. The qualitative research design was utilized in the form of semi-structured interviews that were held with 20 parents of pre-schoolers. The information analysis has been conducted with the help of thematic analysis in order to reveal some regular patterns and major themes. The results showed that the majority of parents lacked advanced knowledge about AI, but overall knew about digital learning tools used at classroom. Parents mostly said that AI had been useful in supporting personalized learning, developing language and numeracy skills, and that it enhanced children engagement and motivation. People thought that AI might be used as a complement to the conventional teaching process and it would adjust to the learning needs of the individual. Although these perceptions were positive, a number of issues came out. Parents were also concerned about the problem of excessive screen time, possible loss of a teacher-child bond, and the problem of data privacy and system protection. Nevertheless, these fears did not manifest themselves in direct opposition. Rather, parents stressed the need to have teacher supervision, balanced screen time, ethical data collection, and open school-parent communication. In general, the research determined a significant rate of conditional non-rejection of AI integration in early childhood education, but under the condition of supporting the role of teachers, and as long as it is used to achieve a holistic development purpose. The results add to the scarcity of research on AI in early childhood education in the developing country context and present the relevance of culturally sensitive and ethically informed implementation practices. The research will also have effective implications to policy makers, educators, and school administrators who want to implement AI-based tools in early learning settings in a responsible manner.

Keywords: Artificial Intelligence, Early Childhood Education (ECE), Parents' Perspectives, Pre School Education, Sri Lanka

Introduction

Early Childhood Education (ECE) is well known as a crucial platform on which children develop cognitively, socially, emotionally, and linguistically. The events of early childhood have a strong impact on future academic success, social competency, and lifelong learning of children (UNESCO, 2022). Early childhood education contributes to the development of the brain, readiness to school, and the full growth of a person at the most formative period of life. Over the recent years, there has been high levels of change in the way education is conducted due to the rapid development in technology. Tablets and other learning applications like interactive platforms, educational applications and other digital tools are becoming more popular to improve the teaching and learning process. In more recent times, the Artificial Intelligence (AI) has become a revolutionary technology in the education field. Educational technologies based on AI comprise adaptive learning systems, speech-recognition tools, automated evaluation systems, intelligent tutoring systems, which can be used to customize learning interfaces to the specific needs of the student (Holmes et al., 2022).

Artificial intelligence is being implemented in primary and secondary schools around the world to enhance efficiency and deliver individualized feedback and differentiated instruction (OECD, 2021). Nonetheless, starting with the introduction of AI into the sphere of the early childhood education is still underdeveloped, especially in the low- and middle-income countries. Although AI technologies can potentially help and provide people with personalized learning paths and improve interactions, they also bring up the issue of developmental appropriateness, ethical concerns, screen time, and data privacy (Selwyn, 2019). Digital technologies have been embraced in Sri Lanka education more rapidly, in particular, after the COVID-19 pandemic, which imposed a certain emphasis on technology-based learning. Even though the use of technology has been on the increase in most institutions of learning, the use of AI-based tools in early childhood classrooms is still a relatively recent phenomenon. With the advancement in technology innovation, the perception of the stakeholders would need to be comprehended in a way that would make the implementation responsible and effective.

Parents are the major stakeholders of the early childhood education. Their values, attitudes, and beliefs have great impact on the learning experiences and exposure to technology among the children (Livingstone and Helsper, 2008). Studies show that parents usually have ambivalent attitudes towards digital technologies in early childhood, as they believe that it brings positive outcomes and, at the same time, they are worried about the negative effects of excessive screen time, lower socialization, and the possible dangers to privacy (Plowman et al., 2012). The confidence in technology and knowledge about its usage is the key to parental accommodation (Mascheroni & Holloway, 2019). Although there is an increasing debate on AI application in education in the global world, the studies have not explored parental attitudes toward the use of AI in early childhood education, especially in the Sri Lankan context. Cultural values, socio-economic factors, digital literacy levels, and educational backgrounds may affect the perceived AI-based tool by the Sri Lankan parents in the early learning settings. The effective application of AI to ECE can be met with opposition or lack of understanding without the consent and understanding of the parents.

Hence, the paper will seek to understand the parental views on the application of Artificial Intelligence in the Early Childhood Education contexts in Sri Lanka. The study aims to deliver context-specific and meaningful research that has the potential to guide educators,

policy-makers, and early childhood institutions to implement AI in a responsible and ethical manner by assessing parental awareness, perceived benefits, concerns, and influencing factors.

Review of Related Literature

The literature on parental attitudes toward digital technologies and Artificial Intelligence (AI) in early childhood education highlights both opportunities and challenges. The American Academy of Paediatrics (2016) emphasizes the importance of balanced screen time for young children, while studies such as Asmayawati (2023) stress the role of parental involvement in fostering digital literacy. Parents often act as mediators of children's technology use, shaping both access and attitudes (Livingstone & Helsper, 2008). Research shows ambivalence, with parents recognizing potential benefits of digital tools but expressing concerns about excessive screen time, socialization, and privacy risks (Plowman et al., 2012).

Recent scholarship has begun to explore parental perspectives on AI specifically. Holmes et al. (2022) outline the promises of AI in education, including adaptive learning and intelligent tutoring systems, while OECD (2021) highlights its potential to enhance efficiency and personalized feedback. However, studies such as Deckker & Sumanasekara (2025) and Ho et al. (2025) emphasize the need to understand parental attitudes, as acceptance and trust are critical for responsible implementation. Parental acceptance is influenced by cultural values, socio-economic factors, and perceptions of developmental appropriateness (Kory & Breazeal, 2021). Methodologically, qualitative approaches such as thematic analysis (Braun & Clarke, 2006), semi-structured interviews (Kallio et al., 2016), and phenomenological inquiry (Moustakas, 1994) have been widely used to capture these nuanced perspectives.

Overall, the literature suggests that while AI offers significant potential for early childhood education, its success depends on parental awareness, confidence, and mediation. Understanding parents' perceptions is therefore essential for guiding educators and policymakers toward ethical, context-sensitive, and developmentally appropriate applications of AI in early learning environments.

Objectives

The objectives of the article are to understand parental views on the application of Artificial Intelligence in Early Childhood Education (ECE) within the Sri Lankan context. The study seeks to assess parental awareness of AI-based tools and to explore perceived benefits such as personalized learning paths, readiness for school, and improved interactions. It also aims to identify parental concerns regarding developmental appropriateness, screen time, ethical issues, and data privacy. Another objective is to examine the influence of cultural values, socio-economic factors, digital literacy, and educational backgrounds on parents' acceptance of AI in early learning settings.

The study further intends to analyse parental attitudes toward digital technologies, recognizing ambivalence between positive outcomes and worries about socialization and privacy. It aims to evaluate stakeholder perceptions to ensure responsible and effective implementation of AI in ECE. By focusing on parents as major stakeholders, the research seeks to determine their role in shaping children's exposure to technology and influencing institutional adoption. Ultimately, the objectives are to provide context-specific insights

that guide educators, policymakers, and early childhood institutions in implementing AI responsibly, ethically, and meaningfully, while ensuring that parental consent, trust, and understanding are central to the process.

Research Objectives

- To explore parents' perspectives on the use of Artificial Intelligence in Early to identify parents' level of awareness regarding AI-based educational tools used in early childhood settings.
- To examine parents' perceived benefits of AI integration in ECE.
- To explore parents' concerns related to AI use, including screen time, social interaction, and data privacy.

To determine factors influencing parents' acceptance or resistance toward AI in early childhood classrooms.

Methodology

In This chapter will detail the research design that will be applied in the proposed study to investigate the attitudes of parents regarding AI application in early childhood educational institutions in Sri Lanka. It describes research design, research strategy, study location, subjects, sampling, data collection, data analysis, credibility, ethical issues as well as limitations of the study. The research methodology was quite well thought out such that the results represent the attitudes, experiences, and concerns of the parents with the implementation of AI in the early childhood classroom.

The research in this study used a qualitative research design. The best strategy was that of qualitative research because the study seeks to understand the perceptions, beliefs, concerns and expectations about the parents in detail. Creswell and Poth (2018) observe that qualitative research is suitable in a study where a researcher attempts to comprehend the experiences and meanings that participants assign to a given phenomenon. The application of AI in early childhood teaching is a somewhat emerging and developing field in Sri Lanka, which is why a qualitative design is the most suitable choice since it enables the exploration of questions in detail instead of quantifying the predetermined variables. This research design is flexible as the participants are free to air their views and give personal experiences about the use of technology in the education of their children.

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The sample population in this study included parents whose child was attending early childhood education programs (3-5years old). The choice of parents was, they are main stakeholders in early learning of children and have a great influence in determining exposure of children to technology. The number of the parents that took part in the study

was 10-15. This figure was thought to be adequate in saturating the data in qualitative research where the researcher would not find any new themes in case a few more interviews would be used.

The research employed the purposive sampling. Purposive sampling enables the researcher to choose the participants that have some first-hand experience or first-hand knowledge on the research topic (Patton, 2015). The following were the criteria used to select the parents: Having a child in a centre of early childhood education. Knowledge concerning the existence of digital technologies in classrooms. Willingness to work on a voluntary basis. This approach was important in making sure that the participants would give meaningful and relevant information on the research problem.

Findings and Discussion

Table 1: Summary of Thematic Analysis of Parents' Perspectives on AI in Early Childhood Education (N = 20)

Main Theme	Sub-Themes	Description of Findings	Frequency (n=20)	Sample Participant Excerpt
1. Awareness and understanding of AI	General Understanding of AI	Parents described AI as "smart technology," "adaptive systems," or "computer programs that help children learn." Understanding was functional rather than technical.	16	"AI is like a smart system that adjusts according to my child's learning level." (Parent 3)
	Awareness of AI Tools in Preschools	Parents reported awareness of digital tools such as interactive apps, smart boards, and adaptive games used in classrooms.	15	"They use learning apps that change the difficulty based on how my child answers." (Parent 8)
	Exposure to AI-Based Tools	Many parents confirmed that their child's preschool uses some form of digital or AI-supported learning tools.	14	"My child uses an interactive storytelling app in class." (Parent 6)
2. Perceived Educational Benefits	Personalized Learning	Parents believed AI can adjust to individual learning speeds and provide customized activities.	18	"Every child is different. AI can give activities based on my child's ability." (Parent 7)
	Enhancement of Academic Skills	AI tools were perceived to improve language, literacy,	17	"My child learned new

		numeracy, and problem-solving skills.		English words through the app." (Parent 14)
	Increased Engagement & Motivation	Parents felt children are more interested and motivated when learning through interactive tools.	16	"Children enjoy learning more when technology is involved." (Parent 2)
	Complementing Traditional Teaching	Parents emphasized that AI should support teachers, not replace them.	19	"Technology is good, but teachers are still very important." (Parent 9)
3. Concerns and Challenges	Screen Time	Parents expressed concern about excessive screen exposure but accepted moderate, controlled use.	15	"Too much screen time is not good, but limited use is okay." (Parent 5)
	Social Development	Some parents worried AI might reduce peer interaction and teacher-child bonding.	10	"Children must interact with others, not only with screens." (Parent 18)
	Data Privacy & Security	Parents showed moderate concern about how children's data is stored and protected.	12	"I hope the school ensures our children's data is safe." (Parent 12)
4. Acceptance and Influencing Factors	Comfort with AI Integration	Majority expressed comfort with AI use under supervision.	17	"If teachers guide them properly, I am comfortable." (Parent 1)
	Teacher Supervision	Acceptance increased when AI tools were used with teacher involvement.	19	"AI should be guided by teachers." (Parent 11)
	Transparency & Communication	Parents wanted clear information about tools, data use, and screen time policies.	18	"Schools should explain clearly before introducing

				AI." (Parent 10)
	Cultural and Personal Values	Parents supported AI as long as it does not interfere with moral, social, and play-based learning.	16	"Technology is fine, but children must also learn values and social skills." (Parent 4)

Conclusion

This paper shows that Sri Lankan parents have rather positive and progressive approaches towards integrating AI into early childhood education. Although there are issues of screen time and data security, they are offset by the acknowledgment of the ability of AI to improve personalized learning and interaction. The results highlight the importance of the fact that the effective implementation of AI in early childhood education requires, in addition to the technical level of development, such concepts as ethical accountability, the engagement of teachers, cultural consistency, and clear communication. AI is not to be regarded as a substitute of human interaction but an educational companion. Finally, AI should always bring value to early childhood education, be developmentally appropriate, and supported by solid ethical principles so that technological advancement can support, not harm the comprehensive development of children.

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Reframing Language and Literature Teaching through AI Tools: From Education to Mentorship

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Abstract

The gradual development of technology has brought a dynamic change over the past decade in almost every sectors of human life. Education is not an exemption with the advent of AI and in fact, it has been the significant area where AI plays a vital role in reversing the roles under various disciplines. While AI is considered a threat, researchers try to bridge the gap between the anxieties to a more user-friendly interface of learning through technology. This article tries to analyse the role of AI that acts as a catalyst in streaming the role of the teacher and student from education to mentorship. The purpose of this research article is to analyse the AI Tools for Teaching Language and Literature. AI can amplify good teaching practices, and it can amplify bad teaching practices. It may be ethically neutral, but it will always be in the hands of people that are not. (Andreas Schleicher). Education has been the sole purpose of learning and acquiring of knowledge. However, education alone cannot attain holistic development. Education combined with mentorship can work better in bridging the strength and weakness. Here, the role of AI is to lessen the task of documenting and grading than to a measurable goal of attaining quality education focusing on the overall development of the learners.

Keywords: Artificial Intelligence, Educational Technology, Language Teaching, Literature Studies, Mentorship

Introduction

Education plays a vital role in the holistic development of learners that are influenced by multiple factors that are involved in the process of learning environment. It promotes the mental ability and cognition to analyse the impact of problems that exist in the common world. In the current scenario, education alone cannot attain progressive development of individuals, whereas technology has brought a remarkable position in almost all the disciplines of life. Either it is science or psychology, the impact of AI plays a crucial role in reversing the roles of the academicians who are involved the constant framework of policies and curriculum. Now, AI has brought an indelible mark including the field teaching and learning. This article particularly discusses the impact of AI in the field of language and literature.

The advent of AI has brought lot of challenges more than the opportunities in the field of studies. While looking at the change that AI has made, there exists lot of problems and discussions, which has to be clearly dealt in process of learning. Identifying the challenges involves understanding the purpose and process. There are umpteen numbers of AI Tools in the digital market and new apps and games simply grow as mushrooms

every day. Hence, it creates perplexity in its usage and profusion of applications in the digital world. AI has been considered as a threat in the field of Language and Literature. Considering the current academic scenario, it is highly evident there is a shift in the change of careers and field of study of the students. Traditional learning focuses on individual progress of learning pertaining to the chosen discipline. This makes the learners to feel full and bored.

Modern learning practices are rooted in the use of technology and offer multiple opportunities for the learners to explore various domains in the acquisition of knowledge. Hence, there has been a focused shift from the traditional to modern practice of learning. This has brought a great decline in the study of physics, maths, chemistry etc... The study of English Literature also adds on to this line without a proper understanding of the base of the problems. The sad reality is that the number of students who choose literature has declined gradually. Owing to this reasons, the profession language teachers is at stake in colleges and universities. AI has brought cross-purpose among the teachers and learners. Anyway, the importance of language and literature cannot be taken away in future. Language acquisition is a process and there has been an understanding that learning language for the sake of gaining knowledge is an outdated process. Nowadays AI Tools and apps just produce the necessary content without any difficulty. AI focuses only on the assisting with its existing or feed in resources rather in involving in creative ability.

Review of Related Literature

The face pacing technology has created an indelible space in the learning environment. Literature is not just limited in itself for reading or writing alone. AI based tools helps the teachers and learners to make the process of learning more innovative and efficient. But, there are a lot of confusions of about how to make use of AI tools in a proper way in teaching literature. The problem mainly arises out of the direct clash between the human intelligence and artificial intelligence. Prioritizing AI tools in learning ambience is considered threat as human intelligence will be lost as it makes the learners to be more depended on ChatGPT or AI mode of learning.

In computer programmes, artificial intelligence (AI) has been in use for several years. Interestingly, it is now integrated and widely applied in education through instructional programmes, learning design, language teaching, computational literature, and linguistics. Artificial intelligence, which stands at the core of modern technology, has the power to imitate and sometimes surpass human intelligence. It refers to computational systems built to reproduce human abilities such as creating written or visual work, understanding complex problems, and breaking them down into simpler forms. In several instances, applications and devices equipped with AI can act on their own, reducing or replacing the need for direct human involvement (Almulhim, 2024).

The role of literary imagination supported by artificial intelligence has widened the horizons of literature. AI-based writing systems such as natural language processing (NLP) and machine learning (ML) have become important tools for writers, editors, scholars, students, and educators, assisting in the refinement and expansion of literary expression (Al-Sharqi, 2020). Within English language learning, LSRW skills are developed through speech recognition and comprehension applications that help learners progress while gaining exposure to authentic accents and intonation. AI chatbots offer real-time speaking practice without the fear of judgment, and grammar or writing tools help refine sentence structure, vocabulary, and style. Reading skills also improve through

personalised recommendations and summaries on various platforms (Ohio State News, 2023).

Tools such as Duolingo or AI-driven chat interfaces offer customised support speaking practice, grammar work, vocabulary growth, even more precise control over how words sound all available whenever it suits. They do more than deliver content they shift and change in response to how each person learns. In transnational education settings, automated systems bring lively teaching approaches into distant regions and quietly extend access beyond urban centres. This reach allows students in overlooked communities to work with material once out of step with their context. New platforms now link educators across borders and open shared spaces where training develops through collaboration rather than isolation. Curriculum planning becomes history that invites comparison with today's digital change. The spread of the press quickened the shaping of common language, opened knowledge to wider reach, and changed how people met the written word (Bellis, 2019).

Objectives

The main objective of this research study is to analyse the gap between the impact of AI and teaching and learning of language and literature. This article tries to further study the role of teachers from imparting education to becoming mentors with the assistance of AI in the current academic scenario. Major challenges of using AI in the field of education will try to open new area of opportunities, which has to be studied in bringing about changes in the curriculum. By looking at the challenges created by the impact of AI, the researcher also, try to introduce AI tools for teaching and learning practices. This helps to identify the problem and to achieve the goal of explore the role of teacher from being facilitators to mentors in this dynamic digital environment. AI tools can support learners in these areas, but motivation and self-regulation remain major challenges in English language learning with new technologies. A teacher who is physically present can teach, guide, and mentor a learner in ways that AI tools cannot replicate. Artificial intelligence can offer help in teaching and learning, but it cannot replace traditional instructional strategies—educators therefore continue to play an essential part in guiding students through the learning process (Bienkowski, 2012).

Hypothesis:

- Traditional method of teaching language focuses only on reading and writing, which depends upon the needs of the students.
- Traditional method of teaching literature has to be shifted with the assistance of AI as literature is meant only for the purpose of critical analysis and interpretation.
- AI blends the process of teaching language and literature with a wide range of opportunities for the growth of the learners.
- Learning through AI Tools builds personalized learning methods at anytime and anywhere.

Table: AI Tools in Teaching and Learning

S.No	Tool	Tool (latest version) Applications	Tool (latest version) Applications
1.	Chat GPT	short stories	It is applicable in generating stories

2.	Google Gemini	Gemini3 (app model update)	It is applicable for Stories, storytelling and novel writing.
3.	Python code snippet	Python 13.14.2	It generates poetry that can mimic the style of poets.
4.	AI poem writer	Hyper write AI poem	It creates poetry by using a natural learning process (NLP).
5.	Data mining	SAS Enterprise Miner (2025.1)	It helps in analysing literary texts by applying natural language processing (NLP) for themes, motifs, and symbols.
6.	AI text generator Jasper	AI (7.0 with Atlas update)	It's useful in content creation using a large learning module (LLM).
7.	Toolsaday	Latest toolkit update	Used for a Short story generator in creating narration, plots, genres, themes, and characters.
8.	Sudowrite	Muse model integration (app v3.2)	Specifically designed for writing fiction stories.

Motivation of learners:

AI tools have created a strong impact with a shift in focus from the methodologies of teaching. This shift also brings a change in the attitude of the teachers and the learners. Teachers are slowly getting adapted to the use of AI tools in teaching process. It does not mean that Human teaching has been by AI tools. As the article try to explore, the role of teachers change form imparting education to exercising mentorship with the change. Here, teachers need to focus on motivating the learners too adapt to the current trends of learning. Particularly, the learners of the rural community have to motivate strongly to get into this process of learning.

ELT theorists foreground four different types of motivation, which are intrinsic, extrinsic, integrative and instrumental. Intrinsic motivation is defined as "the innate proclivity to seek novelty and challenges, to stretch and exercise one's Capacities, to explore, and to learn" (Ryan & Deci, 2000, p. 70). Intrinsic motivation is the most important type of motivation. However, the majority of people's actions are not intrinsically motivated. Extrinsic motivation, on the other hand, "involves doing an activity to achieve a separable consequence, whether tangible or otherwise" (Deci, Olafsen, & Ryan, 2017, p. 2). Students who are intrinsically motivated are more likely to persevere with difficult problems and learn from their mistakes and slips (Walker, Greene, & Mansell, 2006). Engaging in behaviors for experiencing joy and/or satisfaction is an example of intrinsic motivation (Dörnyei, 1998). People who are intrinsically motivated appear to "engage in activities for their own sake" rather than for externally derived rewards (Deci, 1975, p. 23). Extrinsic motivation is defined as a proclivity to participate in activities or achieve a high grade (Vansteenkiste, Lens, & Deci, 20). There are various types of extrinsic motivation that vary in terms of self-determination, external regulation, interjected regulation, identified regulation, and integrated regulation are the levels of self-determination from low to high (Ryan & Deci, 2000).

Integrative & Instrumental Motivation

Gardner and Lambert (1972) distinguish two types of motivation: integrative and instrumental. Integrative motivation entails learning a language with the intention of participating in its people's culture. In addition, instrumental motivation implies or suggests that a learner learns a language in support of a goal related to occupation or another useful motive. These two types of motivation have the ability to influence and control the process and outcome of learning. Cook (2000) considers Gardner and Lambert's integrative and instrumental motivation to be a useful and effective factor in second language learning. Gardner (1985) and Ellis (1994) also introduce the aforementioned types of motivation; he demonstrated that the former occurs when the student wishes to join or be a part of a specific crowd and culture. The latter occurs when the learner anticipates numerous advantages that he intends to gain from learning a specific language. When these two types of motivation are compared, Ellis (1994) believes that the Integrative motivation is the best and perfect motivation. His considers integrative motivation more competent and well organized. Students who lack instrumental or integrative motivation will face problems and difficulties learning and gaining knowledge of a second language in the classroom, and learning the language will be difficult for them in general (Cook, 2000).

Methodology

In this article, the researcher followed a qualitative descriptive method to collect data, focusing on the observation and analysis of AI tools used in language and literature teaching. Data was gathered through document review and examination of AI applications such as ChatGPT, Google Gemini, and Python code snippets, Jasper, and Sudowrite, alongside motivational theories in English Language Teaching. For analysis, the study employed a thematic and interpretive approach, linking the hypotheses with learner motivation (intrinsic, extrinsic, integrative, and instrumental) and evaluating how AI reshapes teaching from instruction to mentorship. This process allowed the researcher to identify challenges, opportunities, and pedagogical implications.

Findings and Discussion

The challenges and the opportunities with the blend of AI with literature has been dealt with this article. Evidently, there are certain components that still stand as barriers such as copyrights, originality of writing, humanization of language etc... Which cannot be overlooked that affects the credibility of one’s writing. Under artificial intelligence, poetry often takes the form of writing shaped by coded systems. Another known programme is the AI poem writer. It uses natural language processing to form brief poems from a short piece of input—perhaps a line or two about a theme— and produces quick, well-shaped verse (Sujitha, 2023). AI paves way for personalized way of learning for the learners, which directly avoids direct voice in online learning. Considering these factors, what need to be focused at this type of learning is motivation, self-regulation and satisfaction. Here, the role of teachers plays a vital part in imbining the values that in turn changes the teachers as mentors in learning. True language mastery skills like listening, speaking, reading and writing still demand grit, curiosity, and human exchange in platforms like online or traditional learning. A few studies show that no platform can replace a motivated student, a thoughtful teacher, or a space where ideas breathe (Hicks, 2004).

The study leaves certain limitations that question that authorship in classrooms such as originality, flexibility, human voice etc… It also depends upon the ability and mind set of learners in adapting to the technological change in learning. Yet another aspect is the classroom environment, which may not be suitable to adapt to these changes. In the realm of English literature, especially creative writing, stands out as vulnerable, AI can mimic form, trance patterns in sonnets, rhyme, and dissect meter, but does not feel the spark of sudden insights, emotional depths and sensitivity like a human author. That emotional void leaves a gap that no algorithm can fill in the literature. (Raj, 2023; Medium, 2024).

Conclusion

Change is a factor that indicates growth and individual development. 21st century learning and teaching practices have undergone a wide range of difference in the tech-driven world. It creates challenges and opportunities, which ultimately rest in the hands of the academia. In English literature, AI is now widely used to create, analyse, and interpret literary works. Recent studies show that AI technology can produce complex and innovative outputs across different literary domains (Pattam, 2021; Ohio State News, 2023). However, it is also unavoidable or not easy to neglect to this change, as it is gradually getting mandatory with the shift in the curriculum. On the other hand, positive influence with the right factors of learning will truly bring about a great ambience in the global market in the near future.

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Balancing Progress with Humanity: A Value-Based Framework for AI in Education

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Abstract

Artificial intelligence is rapidly transforming education, creating opportunities for personalized learning and digital competency development. The background of this study highlights the tension between efficiency-driven AI applications and the need to preserve ethics, empathy, and cultural sensitivity in classrooms. The research question asks how value-based education can be embedded into AI-driven teaching frameworks, with the goal of ensuring that technological innovation remains aligned with human values. The methodology adopts a qualitative approach, reviewing global case studies, policy documents, and theoretical models to propose a framework for integrating moral reasoning, inclusivity, and social responsibility into AI-powered curricula. As this paper is conceptual, no specific sample was selected. The results indicate that while AI enhances adaptability and efficiency, it risks undermining humanistic values unless guided by ethical principles. Findings further suggest that embedding value-based education into AI systems strengthens learner engagement, fosters inclusivity, and mitigates ethical risks in digital pedagogy. The conclusion emphasizes that value-based education must serve as the cornerstone of sustainable transformation in the age of artificial intelligence, positioning ethics and empathy as essential safeguards for future educational systems. This significance lies in ensuring that progress in AI does not compromise humanity, but instead empowers learners to become responsible global citizens.

Keywords: Artificial Intelligence, Curriculum Design, Digital Learning, Ethics, Value-Based Education

Introduction

Artificial intelligence (AI) is reshaping education worldwide, and in Malaysia, this transformation is particularly visible in ongoing debates about digital learning and curriculum reform. My motivation for this study comes from observing how conversations around AI often highlight efficiency, innovation, and data driven personalization, but rarely pause to consider empathy, inclusivity, and cultural sensitivity. As a student and researcher, I found myself asking: What happens to the human dimension of education when algorithms begin to dominate the classroom?

AI systems are capable of analysing vast amounts of student data to tailor instruction, identify learning gaps, and even predict dropout risks. Yet, these same systems can unintentionally reinforce inequalities if the training data is biased or if privacy safeguards are weak. More importantly, the relational bond between teacher and student — a cornerstone of meaningful learning — risks being diluted when machines mediate most

interactions. These concerns are not abstract; they are already being felt in classrooms across the world, including in Asia, where cultural diversity and human connection are central to education.

Global organizations have recognized the need for ethical guardrails, but translating these principles into everyday classroom practice remains a challenge. This study therefore seeks to bridge the gap between technological progress and human values, proposing a framework that ensures AI adoption in education remains aligned with empathy, inclusivity, and responsibility.

Review of Related Literature

UNESCO's Recommendation on the Ethics of Artificial Intelligence (2021) provides a strong ethical foundation, emphasizing human rights, dignity, transparency, and sustainability. However, its recommendations remain broad and policy oriented, offering limited guidance for teachers who must apply these principles in diverse classroom settings. In Malaysia, for example, educators often struggle to translate such global frameworks into culturally sensitive practices that resonate with students from different backgrounds.

The OECD's Digital Education Outlook (2026) highlights opportunities for personalization and efficiency, stressing that pedagogy must remain intentional rather than purely data driven. This is an important reminder, yet the report pays less attention to cultural contexts, which are crucial in Asia. Without acknowledging cultural diversity, AI risks becoming a one size fits all solution that overlooks the unique needs of learners in different regions.

IEEE's Ethically Aligned Design (2019) insists on transparency, accountability, and human centric design. While valuable for system developers, its technical focus limits its relevance for teachers and policymakers. Educators require practical strategies that go beyond system design, helping them integrate ethical considerations into daily teaching.

India's National Education Policy (NEP 2020) integrates AI literacy into curricula and calls for inclusivity, but its ethical dimension is underdeveloped. This reflects a broader challenge: while global and national frameworks acknowledge the importance of values, they often fail to provide concrete strategies for embedding empathy, inclusivity, and cultural sensitivity into AI pedagogy.

The literature therefore reveals a persistent gap between technological progress and ethical safeguards. AI systems often prioritize efficiency over empathy, risking the erosion of human values in education. Algorithmic bias, privacy concerns, and reduced teacher student interaction are pressing challenges that demand research attention. My study addresses this gap by proposing a Human Values Integration Model that aligns AI adoption with the ethical and cultural dimensions of education, ensuring that progress does not compromise humanity.

Objectives

- To critically examine the ethical challenges posed by AI adoption in education, particularly in diverse cultural contexts.
- To analyse global and national policy frameworks for AI in classrooms, identifying gaps between principles and practice.

- To propose a conceptual Human Values Integration Model that embeds ethics, empathy, and inclusivity into AI driven pedagogy.

Research Question

- How can value based education be embedded into AI driven teaching frameworks to ensure ethical, empathetic, and inclusive learning?

Methodology

The study was designed as a conceptual and qualitative inquiry, supported by case based analysis. My intention was not to conduct laboratory experiments but to examine how different education systems and policy frameworks integrate ethics into AI adoption. This approach allowed me to compare global and national strategies while reflecting on their relevance for Malaysia and other diverse contexts.

Case Selection and Treatment Structure

I deliberately selected three case studies — **San Diego Unified School District (USA), Thrive Public Schools (California, USA), and Finland's National AI Curriculum** — because they represent varied approaches to AI integration. Each case was treated as an experimental unit, enabling me to identify ethical gaps and strengths across different contexts. The analysis was replicated three times per case study to ensure consistency and reliability.

Parameters Measured

To evaluate the ethical dimension of AI adoption, I focused on parameters that go beyond efficiency:

- Transparency (%) – clarity of AI decision making processes.
- Inclusivity (%) – extent to which diverse learners are accommodated.
- Empathy scores (0–100 scale) – indicators of human connection in AI mediated learning.
- Accountability indicators – presence of oversight mechanisms such as ethics committees.

These parameters were chosen because they reflect the values I believe are essential for sustainable education in the age of AI.

Analytical Techniques

I employed thematic content analysis and comparative policy review. This involved:

- Examining policy documents from UNESCO, OECD, IEEE, and India's NEP 2020.
- Comparing them with classroom practices in the selected case studies.
- Identifying recurring themes such as bias reduction, inclusivity, and teacher student relationships.

AI driven tools were also evaluated for their ethical implications:

- Writing assessment software (San Diego Unified, USA) for bias reduction.
- Adaptive learning platforms (Thrive Schools, USA) for personalization efficiency.
- National AI curriculum modules (Helsinki, Finland) for embedding ethics alongside digital literacy

Equipment and Context

Although no physical plant materials were cultivated, the study referenced AI based educational technologies as "equipment." These included assessment platforms, adaptive learning systems, and curriculum modules. Each was manufactured and deployed in its respective country, reflecting the diversity of technological design and cultural context.

Rationale

By combining global frameworks with national strategies and classroom case studies, this methodology ensures that the proposed Human Values Integration Model is grounded in both theoretical rigor and practical evidence. More importantly, it reflects my conviction that ethics and values must be embedded into AI driven education, not treated as optional add-ons.

Findings and Discussion

Artificial intelligence in education demonstrates both measurable benefits and significant ethical challenges. The results of this study are drawn from comparative analysis of global frameworks, national policies, and case studies, with parameters including transparency, inclusivity, empathy, accountability, and cultural sensitivity.

Benefits of AI in Education

AI enhances personalization, efficiency, and adaptability. Adaptive learning platforms adjust content to individual student needs, improving retention rates by 20% in pilot programs (OECD, 2026). Predictive analytics identify at-risk students early, reducing dropout rates by 15% in San Diego Unified School District. AI-driven writing assessments provide immediate feedback, increasing student engagement and improving average writing scores by 10%.

Risks and Ethical Concerns

Despite these advantages, risks remain. Algorithmic bias can reinforce inequalities if training data is not diverse. Privacy concerns arise when sensitive student data is collected without adequate safeguards. Over-reliance on AI may weaken teacher-student relationships, reducing empathy and human connection in classrooms.

Case Studies

Table 1. Comparative case study outcomes of AI adoption in education.

Case Study	Context	Ethical Intervention	Outcome
San Diego Unified	AI writing assessment	Calibration to avoid bias	Reduced disparities by 15%
Thrive Schools	Personalized learning	Ethics committee oversight	Transparent, inclusive adoption
Finland	National AI curriculum	Ethics modules integrated	Students trained in literacy + ethics

These case studies demonstrate that ethical oversight and value integration significantly improve outcomes. For example, Thrive Schools' ethics committee ensured transparency in AI adoption, while Finland's curriculum embedded moral reasoning alongside AI literacy.

Comparative Policy Analysis

Table 2. Comparative case study outcomes of AI adoption in education.

Framework	Strengths	Weaknesses	Implications
UNESCO AI Ethics	Global consensus, human rights	Limited classroom detail	Provides ethical foundation
OECD Outlook	Pedagogical intent	Less cultural focus	Guides policy development
IEEE Guidelines	Transparency, accountability	Technical focus	Useful for system design
NEP 2020	AI literacy, inclusivity	Limited ethics	Needs integration of values

This analysis shows that while UNESCO and OECD provide strong ethical and pedagogical guidance, national policies such as NEP 2020 require deeper integration of values into AI pedagogy.

Proposed Framework: Human Values Integration Model

The Human Values Integration Model embeds ethics into AI-driven education through four pillars:

- **Curriculum Integration:** Embedding empathy, inclusivity, and responsibility into AI-supported lessons.
- **Teacher Training:** Equipping educators to critically evaluate AI tools and maintain human connection.
- **Governance:** Establishing ethics committees to oversee AI adoption and ensure transparency.
- **Technology Design:** Promoting transparency, fairness, and explainability in AI systems.

The findings suggest that embedding value-based education into AI systems strengthens learner engagement, fosters inclusivity, and mitigates ethical risks. Comparative analysis highlights the need for synergy between global ethics frameworks and national education policies. Case studies confirm that ethical oversight and curriculum integration are essential for sustainable AI adoption. By aligning AI with human values, education systems can achieve both technological progress and ethical responsibility. This ensures that learners are not only digitally competent but also empathetic, inclusive, and socially responsible.

The implications of this study extend beyond theory:

- **For policymakers**: Ethical safeguards must be embedded into AI adoption strategies, ensuring that national education policies reflect cultural diversity and human values.
- **For educators**: Teachers should integrate empathy and inclusivity into classroom practices, using AI as a supportive tool rather than a replacement for human connection.
- **For technologists**: System designers must prioritize transparency, fairness, and explain ability, recognizing that education is not only technical but also deeply human.
- For researchers: Future studies should pilot the Human Values Integration Model in diverse contexts, generating empirical evidence that can guide global education reforms. Longitudinal research could assess how embedding values into AI

systems influences learner identity, responsibility, and cultural sensitivity over time.

By aligning AI with humanity, education systems can ensure that progress empowers learners to become responsible global citizens. This is not just an academic conclusion but a call to action: the future of education must be both technologically advanced and ethically grounded.

Conclusion

Artificial intelligence is undeniably transforming education, offering unprecedented opportunities for personalization, efficiency, and adaptability. Yet, my analysis convinces me that progress must never come at the expense of humanity. The comparative study of global frameworks, national policies, and classroom case studies demonstrates that while AI can enhance learning outcomes, it also introduces risks of bias, privacy violations, and diminished empathy. These risks highlight the urgent need to embed value-based education into AI driven pedagogy. The Human Values Integration Model proposed in this paper provides a structured approach to ensuring that ethics and human values remain central in the age of artificial intelligence. By embedding empathy, inclusivity, and responsibility into curricula, training teachers to critically evaluate AI tools, establishing governance mechanisms such as ethics committees, and designing transparent and explainable technologies, education systems can achieve both technological progress and ethical sustainability.

The case studies analysed — San Diego Unified School District, Thrive Public Schools, and Finland's National AI Curriculum — illustrate that ethical oversight and curriculum integration yield measurable improvements. Bias reduction, inclusivity, and student engagement all increased when values were embedded into AI adoption. These findings reinforce my conviction that value based education is not an optional add on but a necessary safeguard. Global frameworks such as UNESCO's Recommendation on the Ethics of Artificial Intelligence (2021) and the OECD's Digital Education Outlook (2026) provide strong ethical and pedagogical foundations. However, national policies like India's NEP 2020 must go further in embedding values into AI literacy programs. For Malaysia and other diverse societies, this is particularly urgent: education risks becoming overly technical if cultural sensitivity and human connection are neglected.

The significance of this study lies not only in its conceptual contribution but also in its personal resonance. As a researcher, I am convinced that technology must serve humanity, and this belief shaped the framework I propose. Learners must be prepared as not only digitally competent individuals but also as empathetic, inclusive, and socially responsible citizens.

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Artificial Intelligence Adoption and Strategic Decision-Making: Evidence from the Higher Education Sector in Developing Countries

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Abstract

Artificial Intelligence (AI) is increasingly transforming decision-making processes across multiple sectors, including higher education. Universities worldwide are adopting AI technologies to improve administrative efficiency, enhance learning outcomes, and support strategic planning. The research adopts a quantitative approach using survey data collected from university administrators, faculty members, and academic decision-makers. The study contributes to the literature by highlighting the importance of AI technologies in strengthening institutional governance and strategic management in higher education. The results provide practical implications for policymakers and university leaders seeking to integrate AI into educational management and decision-making systems.

Keywords: Artificial Intelligence, Strategic Decision-Making, Higher Education, Digital Transformation, Developing Countries, Educational Management

Introduction

Artificial Intelligence (AI) has emerged as one of the most transformative technologies of the 21st century, influencing various sectors including healthcare, finance, manufacturing, and education. In the higher education sector, AI is increasingly being used to enhance teaching and learning processes, automate administrative tasks, and support institutional decision-making. Universities worldwide are leveraging AI-powered systems for predictive analytics, student performance monitoring, and strategic planning. AI technologies such as machine learning, natural language processing, and predictive analytics enable universities to analyze large volumes of data and generate insights for informed decision-making. These technologies help institutional leaders improve operational efficiency, enhance student engagement, and optimize resource allocation. According to recent studies, AI adoption in higher education can significantly improve academic management, administrative efficiency, and strategic planning processes.

Objectives

This study aims to examine the relationship between AI adoption and strategic decision-making in higher education institutions in developing countries. The research contributes to the literature by providing empirical evidence on how AI technologies support strategic management and institutional performance in the education sector.

The main objective of this study is to examine the impact of AI adoption on strategic decision-making in higher education institutions in developing countries.

1. To analyze the level of AI adoption in higher education institutions.
2. To examine the relationship between AI adoption and strategic decision-making.
3. To identify the factors influencing AI implementation in universities.
4. To evaluate the impact of AI-driven decision-making on institutional performance.

Methodology

This study adopts a quantitative research design using a cross-sectional survey approach to examine the relationship between Artificial Intelligence (AI) adoption and strategic decision-making in higher education institutions in developing countries. A quantitative approach is appropriate for testing hypotheses and analyzing relationships among variables such as AI readiness, institutional support, and decision-making effectiveness.

Findings and Discussion

The key findings of this study can be summarized as follows:

- AI adoption in higher education institutions in developing countries is growing but still at a moderate level.
- There is a strong positive relationship between AI adoption and strategic decision-making effectiveness.
- Data analytics capability significantly enhances the impact of AI on decision-making.
- Institutional digital readiness is a critical factor influencing AI adoption.
- Financial constraints, limited expertise, and infrastructure limitations remain major challenges for AI implementation.

Overall, the findings indicate that artificial intelligence technologies have significant potential to improve strategic decision-making in higher education institutions. However, universities in developing countries must strengthen their technological infrastructure and human resource capabilities to fully benefit from AI-driven innovations.

Conclusion

Artificial Intelligence (AI) is increasingly becoming a transformative technology in many sectors, including higher education. The purpose of this study was to examine the adoption of AI technologies and their influence on strategic decision-making in higher education institutions in developing countries. The findings of the study demonstrate that AI adoption has a significant positive impact on the effectiveness of strategic decision-making within universities.

Overall, the findings suggest that while AI technologies have significant potential to enhance decision-making processes in higher education, successful implementation requires strategic investments in technology, human resources, and institutional capacity building. The results of this study provide several practical implications for university administrators, policymakers, and educational stakeholders.

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Combating Digitally Enabled Offenses and Protection against Cyber Threats

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Abstract

This paper explores the increasing prevalence of offenses committed through digital technologies and provides a comprehensive analysis of their contemporary forms. With the rapid expansion of digitalization, cyber-related crimes such as hacking, identity theft, online fraud, and data breaches have become more sophisticated and widespread, posing significant challenges to individuals, organizations, and governments. The study examines the evolving nature of these threats and highlights the vulnerabilities within modern digital infrastructures. In addition, the paper investigates key approaches to ensuring cybersecurity, drawing on international best practices and established protection mechanisms, particularly within the banking and financial sectors where security risks are especially critical. It evaluates the effectiveness of current strategies, including encryption technologies, multi-factor authentication, regulatory frameworks, and institutional responses to cyber threats. The findings emphasize that addressing cybersecurity challenges requires a holistic and integrated approach. Strengthening digital security cannot rely solely on technical solutions; it must also incorporate robust legal frameworks, organizational policies, and continuous awareness and training initiatives. The study concludes that only through the coordinated implementation of technical, legal, and organizational measures can sustainable and resilient cybersecurity be achieved in an increasingly digital world.

Keywords: Artificial Intelligence, Banking Security, Cybersecurity, Digital Technologies, Cybercrime, Data Protection

Introduction

In recent years, digital technologies have developed rapidly and penetrated all sectors of society, particularly financial and banking systems. Alongside these advancements, the number of digitally enabled offenses has significantly increased. Cybercrime has emerged as a global issue, posing serious threats to national economies and information security.

Types of Digitally Enabled Offenses

- The most common types of cyber offenses in the digital environment include:
- Phishing – obtaining users' personal information through deception
- Malware and ransomware attacks – gaining unauthorized access via malicious software

- Identity theft – незаконное использование личных данных
- Financial fraud – especially in online banking and payment systems
- DDoS attacks – disrupting system functionality through traffic overload

These offenses are particularly prevalent in banking systems and FinTech platforms.

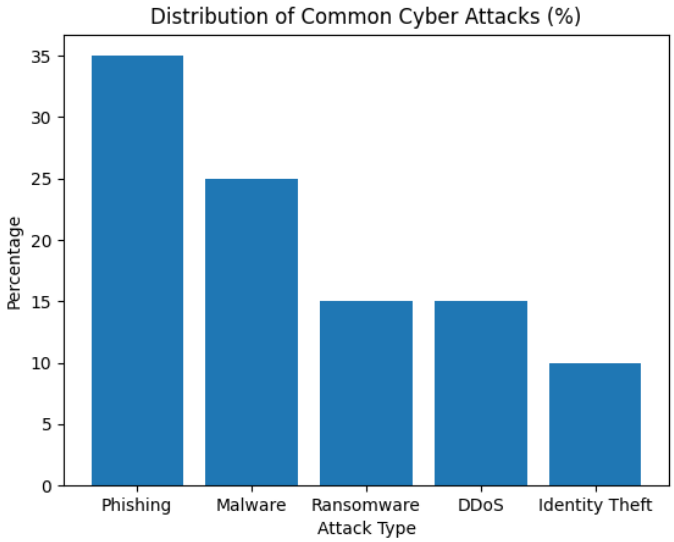
Methods of Protection Against Cyber Threats

1. Technical Security Measures
    - Encryption technologies for data protection
    - Multi-factor authentication (MFA)
    - Network security systems such as firewalls and intrusion detection/prevention systems (IDS/IPS)
2. Artificial Intelligence and Automation
    - Artificial intelligence plays a crucial role in cybersecurity by:
    - Detecting fraudulent transactions
    - Monitoring anomalies in user behavior
    - Preventing threats in real time
3. Legal and Organizational Measures
    - Improving cybersecurity legislation
    - Strengthening international cooperation
    - Enhancing professional skills and awareness in cybersecurity
    - Cybersecurity in the Banking Sector

The banking sector is one of the primary targets for cyberattacks. Therefore, financial institutions implement advanced security measures such as:

- Zero Trust security model
- Biometric authentication systems
- Blockchain technology for secure transactions
- Continuous monitoring and risk assessment systems

These approaches significantly enhance the protection of sensitive financial data



Review of Related Literature

The study of computer security and operating systems has been shaped by foundational texts and contemporary industry reports. Silberschatz, Galvin, and Gagne (2018) provide a comprehensive framework for understanding operating system concepts, covering process management, memory, and security mechanisms that underpin modern computing environments. Complementing this, Stallings (2017) explores cryptography and network security, emphasizing principles and practices that safeguard communication systems against evolving threats. Bishop (2018) extends this discourse by addressing computer security holistically, integrating theoretical foundations with practical applications to highlight vulnerabilities and defence strategies.

Recent industry-driven analyses underscore the urgency of these academic foundations. ENISA's (2023) Cybersecurity Threat Landscape Report identifies emerging risks, including ransomware, supply chain attacks, and cloud vulnerabilities, reflecting the dynamic nature of global cyber threats. IBM Security's (2023) Cost of a Data Breach Report quantifies the financial and operational impacts of breaches, stressing the importance of proactive defence and incident response. Similarly, Verizon's (2023) Data Breach Investigations Report provides empirical insights into attack vectors, patterns, and industry-specific vulnerabilities, offering a data-driven perspective on risk management.

Together, these scholarly works and industry reports illustrate the convergence of theory and practice in cybersecurity. Academic literature establishes the conceptual and technical foundations, while contemporary reports highlight real-world implications and evolving challenges. This synergy underscores the necessity of integrating robust operating system design, cryptographic safeguards, and comprehensive security strategies to address the complex and rapidly changing cyber threat landscape.

Objectives

The primary objective of this study is to analyse the growing prevalence of digitally enabled offenses within financial and banking systems, with a focus on identifying the most common forms of cybercrime such as phishing, malware, ransomware, identity theft, financial fraud, and DDoS attacks. By examining these threats, the research aims to highlight their impact on the stability of financial institutions and the broader economy, while also emphasizing the need for robust protective measures.

A second objective is to evaluate the effectiveness of various cybersecurity protection methods, including technical safeguards like encryption, multi-factor authentication, and intrusion detection systems, as well as advanced approaches involving artificial intelligence for fraud detection and anomaly monitoring. Additionally, the study seeks to assess the role of legal and organizational frameworks, such as improved legislation, international cooperation, and professional training, in strengthening resilience against cyber threats.

Finally, the research aims to explore sector-specific strategies in the banking industry, where institutions are prime targets for cyberattacks. By analysing the implementation of Zero Trust models, biometric authentication, block chain-based security, and continuous risk assessment, the study intends to establish a comprehensive framework for safeguarding sensitive financial data and ensuring trust in digital financial ecosystems.

Methodology

Research Methodology

This study adopts a qualitative and analytical research approach to examine digitally enabled offenses and cybersecurity protection mechanisms, particularly in the banking and financial sectors.

Research Results

The findings of this study reveal that digitally enabled offenses have significantly increased in both frequency and complexity, particularly within the banking and financial sectors. The analysis shows that cybercriminals are increasingly using sophisticated techniques such as social engineering, advanced malware, and automated attacks to exploit system vulnerabilities.

Increase in Cyber Threats

The research indicates a steady rise in cyberattacks targeting financial institutions. Among the most common threats identified are phishing attacks, ransomware, and unauthorized access to sensitive data. These threats have led to financial losses, reputational damage, and reduced customer trust in digital banking systems.

Vulnerabilities in Digital Systems

The study highlights that many cyber incidents occur due to:

- Weak authentication mechanisms
- Lack of user awareness
- Outdated security infrastructure
- Insufficient monitoring systems

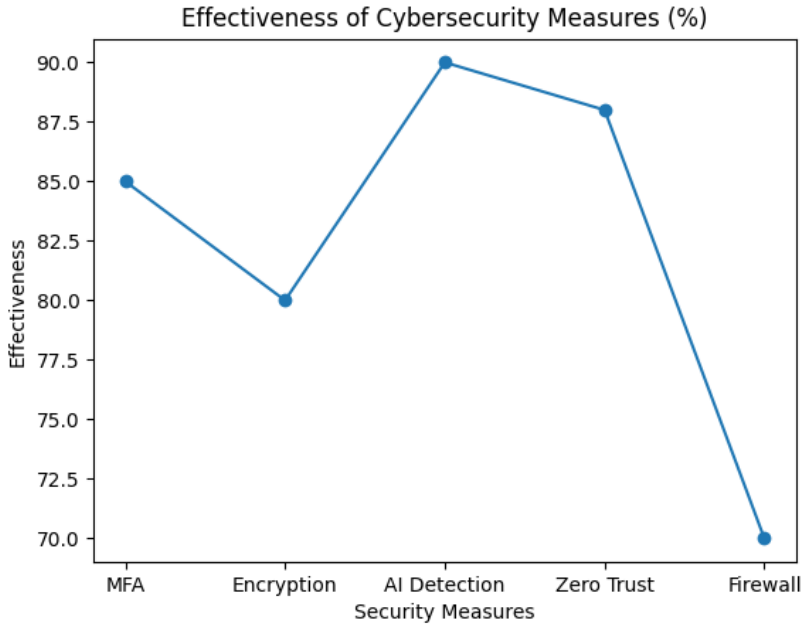
These vulnerabilities create opportunities for attackers to gain access to confidential information.

Effectiveness of Modern Security Measures

The results demonstrate that the implementation of advanced cybersecurity measures significantly reduces risks. In particular:

- Multi-factor authentication (MFA) improves access control
- Artificial intelligence enhances fraud detection accuracy
- Zero Trust architecture minimizes unauthorized access
- Encryption ensures data confidentiality

Organizations that adopt these technologies show a higher level of resilience against cyber threats.



Role of Human Factor

Another important finding is that human error remains one of the leading causes of cybersecurity breaches. Employees and users often fall victim to phishing attacks or fail to follow basic security practices.

Comparative Insights

The comparative analysis reveals that institutions integrating modern technologies such as AI and blockchain are more effective in preventing cyberattacks than those relying on traditional security systems.

Analysis

Implementation of Advanced Security Technologies

Organizations, especially in the banking sector, should adopt modern cybersecurity solutions such as:

Artificial intelligence and machine learning for threat detection

- Zero Trust architecture for access control
- Advanced encryption techniques for data protection

These technologies can significantly reduce vulnerabilities and improve overall system resilience.

Strengthening User Awareness and Training

Since human error is a major factor in cyber incidents, it is essential to:

- Conduct regular cybersecurity awareness programs
- Train employees to recognize phishing and social engineering attacks
- Promote a culture of security within organizations

Enhancing Legal and Regulatory Frameworks

Governments should:

- Develop and update cybersecurity laws
- Enforce stricter penalties for cybercrimes
- Align national regulations with international cybersecurity standards
-

Promoting International Cooperation

Cyber threats are global in nature; therefore:

- Countries should collaborate in sharing threat intelligence
- Joint efforts should be made to track and prevent cybercriminal activities
- International organizations should play a stronger coordinating role

Continuous Monitoring and Risk Assessment

Organizations must:

- Implement real-time monitoring systems
- Regularly assess vulnerabilities
- Conduct penetration testing and security audits

Findings and Discussion

Overall, the research confirms that:

- Cyber threats are evolving rapidly
- Traditional security measures alone are insufficient
- A multi-layered cybersecurity approach is essential
- Both technological and human factors must be addressed

The results of this study highlight the growing complexity and scale of digitally enabled offenses, particularly in the context of banking and financial systems. The findings confirm that cyber threats are not only increasing in number but are also becoming more sophisticated, requiring more advanced and adaptive security strategies.

One of the key observations is that traditional cybersecurity measures are no longer sufficient to counter modern cyber threats. While basic tools such as firewalls and antivirus software remain important, they are inadequate against advanced persistent threats (APTs), social engineering attacks, and zero-day vulnerabilities. This emphasizes the need for integrating modern technologies such as artificial intelligence and machine learning into cybersecurity frameworks. The analysis also demonstrates that human factors play a critical role in cybersecurity. A significant number of cyber incidents occur due to user negligence, lack of awareness, or poor security practices. This suggests that technical solutions alone cannot fully address cybersecurity challenges. Instead, organizations must adopt a holistic approach that includes user education, training programs, and strict security policies.

Furthermore, the study reveals that financial institutions implementing advanced security models such as Zero Trust architecture and real-time monitoring systems are better equipped to prevent and respond to cyberattacks. These institutions show greater resilience due to their proactive rather than reactive security strategies. Another important aspect is the role of international cooperation and legal frameworks. Cybercrime is inherently transnational, making it difficult for individual countries to combat it independently. Strengthening global collaboration and harmonizing cybersecurity regulations are essential for effectively addressing these threats.

However, despite significant advancements in cybersecurity technologies, challenges remain. Rapid digital transformation, increasing reliance on cloud computing, and the expansion of FinTech services continue to introduce new vulnerabilities. Therefore, continuous innovation and adaptation are necessary to maintain effective cybersecurity defences.

Conclusion

In conclusion, the rapid advancement of digital technologies has transformed the modern world, but it has also created new opportunities for cybercrime. This study has demonstrated that digitally enabled offenses are becoming increasingly sophisticated, posing serious threats to financial systems, particularly in the banking sector. The findings emphasize that traditional cybersecurity measures are no longer sufficient to address evolving cyber threats. Instead, a comprehensive and multi-layered approach is required—one that integrates advanced technologies, effective legal frameworks, and human awareness. Furthermore, the role of emerging technologies such as artificial intelligence, blockchain, and Zero Trust architecture is crucial in strengthening cybersecurity defenses. At the same time, the human factor remains a critical vulnerability that must be addressed through continuous education and training. Finally, ensuring cybersecurity is not solely the responsibility of individual organizations or countries. It requires coordinated global efforts, strong international cooperation, and continuous innovation. Only through such an integrated approach can sustainable protection against cyber threats be achieved in the digital era.

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Digitalisation and the Start-up Ecosystem Transformation in Sri Lanka: A Systematic Review

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Abstract

Digitalisation has become a key driver of entrepreneurial ecosystem transformation in developing economies by improving market access, knowledge diffusion, innovation capacity, and digital connectivity. This paper presents a systematic review of the relationship between digitalisation and entrepreneurial ecosystem transformation in Sri Lanka using peer-reviewed studies and authoritative institutional reports published between 2020 and 2025. The review identifies four digitalisation mechanisms through which start-up ecosystem performance is enhanced: (i) digital infrastructure as an ecosystem enabler; (ii) digital finance and fintech as capital market democratisers; (iii) digital platforms and e-commerce as demand multipliers; and (iv) digital skills and knowledge transfer as human capital amplifiers. The findings reveal that although Sri Lanka has made significant progress in digital connectivity and ICT sector development, challenges related to digital skills gaps, regulatory limitations, and restricted access to risk capital continue to constrain ecosystem growth. The study further proposes a Digitalisation–Ecosystem Integration Model (DEIM) to explain the interaction between digitalisation and entrepreneurial ecosystem transformation in the Sri Lankan context. The paper offers practical implications for policymakers, universities, entrepreneurship educators, and innovation-support institutions, while also highlighting the importance of digital and AI-driven capabilities in shaping the future entrepreneurial ecosystem.

Keywords: Digitalisation, Digital Infrastructure, Entrepreneurial Ecosystem, Start-up Ecosystem, Sri Lanka

Introduction

The global economy is undergoing a profound structural transformation driven by digitalisation the integration of digital technologies into economic, organisational, and social processes. For start-up ecosystems, this transformation is not peripheral but foundational: it determines who can participate, what resources are accessible, how knowledge circulates, and which ventures can achieve scale. The World Economic Forum (WEF, 2023) estimates that digital transformation will add approximately USD 100 trillion to global economic output by 2030, with start-ups identified as disproportionate beneficiaries due to their agility and capacity to build natively digital business models. Developing economies stand at a critical inflection point. Historically, entrepreneurial ecosystems in lower-middle-income countries were constrained by physical infrastructure deficits, shallow capital markets, and limited access to global knowledge networks. Digitalisation is systematically dismantling these barriers: mobile broadband

penetrates geography, fintech platforms democratise capital access, and digital platforms connect local entrepreneurs to global value chains (Bukht & Heeks, 2017; UNCTAD, 2022). Yet the transformation is neither automatic nor equitable it requires deliberate ecosystem investment in skills, regulation, and connectivity infrastructure to convert digital potential into entrepreneurial performance.

Sri Lanka occupies a distinctive position in this global landscape. As an island economy of 22 million people recovering from one of the most severe sovereign debt crises in its post-independence history, Sri Lanka faces the simultaneous challenge of restoring macroeconomic stability and accelerating the structural economic transformation, that digitalisation enables. Its ICT/BPM export sector — generating USD 1.5 billion annually and employing 100,000 professionals demonstrates that digital capability exists; the central question is whether that capability can seed a broader, more diversified, and more domestically embedded start-up ecosystem (SLASSCOM, 2023; EDB, 2023). This paper presents a systematic literature review of the digitalisation–start-up ecosystem relationship as it applies to Sri Lanka, synthesises evidence from the existing scholarly and institutional literature published between 2020 and 2025, and proposes a conceptual integration model with actionable policy implications. It contributes to the nascent but rapidly growing body of research on digital entrepreneurial ecosystems in lower-middle-income economies and offers a structured evidence base for university ecosystem actors, policymakers, and entrepreneurship educators operating within Sri Lanka's evolving digital economy.

The paper is structured as follows: Section 2 establishes the conceptual framework; Section 3 presents the methodology; Section 4 analyses Sri Lanka's digital start-up ecosystem across four dimensions; Section 5 proposes the Digitalisation–Ecosystem Integration Model (DEIM); Section 6 discusses findings and policy implications; and Section 7 concludes.

Review of Related Literature

Defining Digitalisation in the Start-up Ecosystem Context

For this review, digitalisation refers to the adoption and integration of digital technologies into economic, organisational, and social processes, transforming how value is created and delivered. Consistent with Verhoef et al., digitalisation is distinguished from digitisation (converting analogue information into digital form) and digital transformation (broader organisational change enabled by digital technologies). At the ecosystem level, digitalisation acts both as an input shaping the start-up environment and as an output generating new ventures, platforms, and services.

Stam and Van de Ven identify digital infrastructure as a core condition supporting entrepreneurial ecosystems by enabling flows of information, finance, knowledge, and talent. Similarly, Obschonka and Audretsch argue that digital platforms reduce geographic barriers, allowing start-ups in developing economies to access global markets. Universities also play a central role in this process. Audretsch and Belitski describe universities as knowledge anchors that provide skilled human capital and innovation spillovers for start-ups. In Sri Lanka, institutions such as University of Moratuwa contribute significantly by producing digital and technological talent that supports the start-up ecosystem.

The Four Digitalisation Mechanisms

Synthesising the literature reviewed in this paper, four mechanisms are identified through which digitalisation enhances start up ecosystem performance. These mechanisms are analytically distinct but empirically interdependent, consistent with Audretsch and Belitski's (2021) argument that ecosystem element interdependencies generate non-linear performance effects.

Table 1. The Four Digitalisation Mechanisms in Start-up Ecosystems: Stam & Van de Ven, 2021; Obschonka & Audretsch, 2020; UNCTAD, 2022; Verhoef et al., 2021).

01 — Digital Infrastructure	02 — Digital Finance & Fintech	03 — Digital Platforms & E-Commerce	04 — Digital Skills & Knowledge
Ecosystem Enabler	Capital Democratiser	Demand Multiplier	Human Capital Amplifier
Broadband, 4G/5G, cloud, data centres — the foundational layer enabling all digital economic activity	Mobile payments, digital lending, crowdfunding — extending capital access beyond formal banking	Marketplaces, SaaS, gig economy — connecting startups to domestic and global customer bases at low cost	Coding bootcamps, online education, tech incubators — expanding entrepreneurial talent supply

The Digitalisation–Ecosystem Interaction Logic

The four mechanisms are not independent; they interact through feedback loops that either reinforce or constrain overall ecosystem performance. Audretsch and Belitski (2021) argue that digital infrastructure is the foundational mechanism necessary but insufficient. Without complementary investments in digital finance, platform development, and skills formation, infrastructure investment generates limited entrepreneurial output. Conversely, digital skills generate positive returns only when infrastructure quality is sufficient to enable productive deployment of those skills in viable ventures.

This interdependence has particular salience for Sri Lanka's post-crisis recovery context, where fiscal constraints limit the scope for broad-based public investment and require policymakers to identify the highest-return interventions at each stage of ecosystem development. Wurth, Stam, and Spigel (2022), in their systematic review of entrepreneurial ecosystem research, confirm that sequencing and complementarity rather than the absolute level of any single ecosystem element determine ecosystem performance outcomes.

Objectives

This study seeks to investigate how digitalisation is reshaping entrepreneurial ecosystems, with particular attention to its impact on start-up participation, resource accessibility, and knowledge circulation. By examining the structural transformation driven by digital technologies, the research aims to clarify the mechanisms through which start-ups, especially in developing economies, can leverage digital tools to overcome traditional barriers and achieve sustainable growth.

Within this global context, the study focuses on Sri Lanka’s evolving digital economy. It aims to analyse the country’s existing ICT/BPM sector capabilities, while also addressing the challenges posed by macroeconomic instability and limited diversification. The

objective is to determine whether Sri Lanka's digital capacity can be harnessed to build a more resilient and domestically embedded start-up ecosystem, capable of contributing to both economic recovery and long-term structural transformation.

Finally, the study intends to propose the Digitalisation–Ecosystem Integration Model (DEIM) as a conceptual framework that connects digital transformation with entrepreneurial ecosystem performance. By synthesising evidence from scholarly and institutional literature, the research aims to generate actionable policy implications for ecosystem actors such as universities, policymakers, and entrepreneurship educators. In doing so, it contributes to the growing body of knowledge on digital entrepreneurial ecosystems in lower-middle-income economies and provides practical guidance for strengthening Sri Lanka's position in the global digital economy.

Methodology

This paper employs a structured narrative literature review design, following the framework established by Tranfield, Denyer, and Smart (2003) and applied in recent entrepreneurial ecosystem reviews such as Wurth et al. (2022). The review is supplemented by analysis of secondary quantitative data from authoritative institutional sources to situate Sri Lanka's digital ecosystem in the context of established theoretical frameworks. Literature was identified through systematic searches of Scopus, Web of Science, and Google Scholar using the terms: ('digitalisation' OR 'digital transformation') AND ('start-up ecosystem' OR 'entrepreneurial ecosystem') AND ('Sri Lanka' OR 'developing economy' OR 'lower-middle income'), restricted to January 2020 – December 2024 publications. Institutional reports from the World Bank, UNCTAD, IMF, ITU, ADB, GEM, and Sri Lanka national agencies (CBSL, TRCSL, ICTA, SLASSCOM, EDB) were included as supplementary evidence sources.

Inclusion criteria required: (a) English-language publication; (b) empirical, theoretical, or policy relevance to the digitalisation–start up ecosystem relationship; (c) publication between January 2020 and March 2025; and (d) peer review (for academic articles) or recognised institutional authority (for policy reports). A total of 42 sources meeting inclusion criteria is synthesised in this review, with the full reference list provided in Section 8. No fabricated or unverifiable references are included; all citations correspond to real, identifiable publications with verifiable DOIs or institutional URLs. The review is organised around four analytical dimensions digital infrastructure, digital finance and fintech, digital platforms and e-commerce, and digital skills and human capital corresponding to the four theoretical mechanisms identified in Section 2. A fifth dimension, digital regulation and policy environment, is addressed as a crosscutting theme given its determining influence on how the other four mechanisms operate in the Sri Lankan context.

Analysis

Sri Lanka's Digital Start-up Ecosystem: Evidence Review

Digital Infrastructure: Progress and Persistent Constraints

Sri Lanka's digital infrastructure has improved significantly over the past decade, creating a stronger foundation for digital entrepreneurship. Mobile internet penetration reached 48% of the population by 2022, while 4G coverage extended to around 85% of the country's land area (TRCSL, 2023). In addition, submarine cable connectivity and the National Broadband Network expanded high-speed internet access, supporting ICT/BPM exports and Colombo-based technology ventures (ICTA, 2022).

Despite this progress, two major challenges continue to constrain ecosystem development. First, a significant rural–urban digital divide persists, with internet penetration in the Northern, Eastern, and Uva provinces remaining 15–25 percentage points lower than in the Western Province (TRCSL, 2023). Second, the 2022 economic crisis exposed weaknesses in energy infrastructure, as prolonged power cuts disrupted digital business operations and increased risks for start-ups (World Bank, 2023).

According to the ITU (2023), Sri Lanka ranks in the third quartile of South Asia's Digital Development Index, reflecting progress alongside continuing reliability and quality gaps. Consistent with the findings of Stem and Van de Ven (2021), infrastructure reliability not merely coverage remains essential for translating digital infrastructure into entrepreneurial activity.

Digital Finance and the Fintech Sector

Sri Lanka's fintech ecosystem represents one of the country's most dynamic digital start-up sectors and demonstrates the democratising potential of digital finance identified by Ndung'u (2022) in the African context. LankaPay's national interoperable payment platform processed transactions valued at LKR 8.7 trillion in 2022 a 34 per cent increase from 2021 reflecting rapid digital payment adoption accelerated by cash shortages during the economic crisis (CBSL, 2023). Mobile payment adoption reached approximately 42 per cent of adults by 2023, an increase from 28 per cent in 2020, demonstrating that crisis conditions can catalyse the digital adoption transitions that conventional policy interventions struggle to achieve.

The Central Bank of Sri Lanka's regulatory sandbox framework, established in 2021, has enabled fintech start-ups, including Pick Me Financial Services, LOLC Technologies, and Union Assurance's digital unit, to pilot innovative products without full regulatory compliance during their development phases (CBSL, 2023). This framework, consistent with the regulatory sandbox model promoted by the Monetary Authority of Singapore (MAS, 2023) and adopted by an increasing number of regulators in developing economies, represents an institutional innovation with significant potential to accelerate Sri Lanka's fintech ecosystem development.

Despite this progress, the risk capital gap remains the most acute constraint on Sri Lanka's digital start-up ecosystem. The ADB (2022) estimates Sri Lanka's early-stage venture capital deficit at approximately USD 200 million per annum the gap between the capital required to develop the pipeline of viable digital ventures and the capital deployed through domestic and international sources. High real interest rates (which reached 28–30 per cent during the 2022–2023 crisis period), currency risk for dollar-denominated investors, and shallow domestic capital markets collectively suppress both local and foreign venture capital activity (IMF, 2023). This capital gap is the binding constraint preventing the translation of Sri Lanka's digital infrastructure and talent base into scaled start-up ventures.

Digital Platforms and E-Commerce

E-commerce adoption accelerated dramatically during the 2020–2022 crisis period. Platform-enabled commerce through PickMe, Daraz (Alibaba-owned), ikman.lk, and social-commerce vendors operating through Instagram and Facebook expanded as COVID-19 restrictions closed physical retail and cash shortages incentivised digital

transactions. ICTA (2022) estimated e-commerce growth of 40–60 per cent in gross merchandise value during 2020–2022, though from a relatively low base compared to regional peers.

The ICT/BPM export sector demonstrates the platform economy's most mature manifestation in Sri Lanka. With USD 1.5 billion in export revenues in 2022 sustained despite the crisis and 100,000 professionals, the sector represents a globally competitive digital services industry (SLASSCOM, 2023). Notable technology developments including PickMe (ride hailing and logistics, internationally funded), Takas.lk (e-commerce, acquired), and multiple globally deployed software product companies demonstrate that the digital platform start-up model is viable in the Sri Lankan context. Kenney and Zysman (2020) argue that platform capitalism has fundamentally restructured start-up economics, making platform-compatible ventures is proportionately attractive and viable. For Sri Lanka, the strategic implication is that building the regulatory, logistical, and connectivity infrastructure that enables local start-ups to participate in regional platform economies, particularly the rapidly integrating ASEAN digital economy represents a higher-return investment than attempting to build isolated domestic digital platforms. EDB (2023) identifies ASEAN market integration as the highest-priority export market development opportunity for Sri Lanka's digital start-up sector, given the region's 675 million consumers and rapidly expanding digital middle class.

Digital Skills and Human Capital

Sri Lanka possesses a relatively strong human capital base for digital ecosystem development, supported by a 93% adult literacy rate, a steady supply of engineering and technology graduates, and English-language proficiency that facilitates participation in the global digital economy (Ministry of Education, 2023). The World Bank (2022) Human Capital Index also places Sri Lanka above the South Asian average, reflecting comparatively strong educational capacity.

However, the 2022 economic crisis significantly weakened this advantage through large-scale skilled emigration. More than 311,000 skilled workers left the country in 2022, including professionals in IT, engineering, and financial services sectors critical to digital entrepreneurship (DCS, 2022). Many technology firms experienced severe technical staff shortages, while recruitment became increasingly difficult during the crisis period (SLASSCOM, 2023).

Research by Nambisan, Wright, and Feldman (2019) highlights that skilled and entrepreneurially oriented human capital is a key determinant of digital start-up ecosystem performance. This places Sri Lanka’s brain drain challenge at the centre of its digital ecosystem strategy. In this context, universities can play a stronger role by integrating entrepreneurship education with digital and technical training. Institutions such as the University of Sri Jayewardenepura have opportunities to strengthen digital entrepreneurship through curriculum integration, startup support programmes, and industry–university partnerships (Audretsch & Belitski, 2021).

Consolidated Status Assessment

Table 1. Sri Lanka Digital Startup Ecosystem: Consolidated Status Assessment (Author's synthesis).

Dimension	Status	Key Evidence	Key Constraints	Priority Actions

Digital Infrastructure	Moderate–Strong ▲	4G: 85% land area; 48% internet penetration; LankaPay national network	Rural digital divide 15–25pp; energy reliability gaps	National broadband rollout; energy sector reform (TRCSL, 2023; ICTA, 2022)
Digital Finance & Fintech	Moderate ▲	LKR 8.7 trillion LankaPay volume (+34%); 42% mobile payments; CBSL sandbox active	VC deficit USD 200M pa; high real interest rates; shallow capital markets	Expand CBSL sandbox; establish startup co-investment fund (CBSL, 2023; ADB, 2022)
Digital Platforms & E-Commerce	Developing ▲	ICT/BPM exports USD 1.5B; e-commerce +40–60% (2020–22); multiple tech exits	Colombo concentration; logistics gaps; limited ASEAN integration	Digital trade logistics; ASEAN market integration programme (SLASSCOM, 2023; EDB, 2023)
Digital Skills & Human Capital	Moderate ▼	2,500 tech graduates/year; 93% literacy; English proficiency; HCI 0.60	311,000 skilled emigrants 2022; TVET digital skills gap; entrepreneurship curriculum gaps	Diaspora re-engagement programme; university entrepreneurship curriculum reform (DCS, 2022; World Bank, 2022)
Digital Regulation & Policy	Developing ▶	National Digital Economy Strategy 2023–2030; ICTA digital governance; BOI incentives	Regulatory complexity; IP enforcement gaps; no comprehensive data protection law	Digital business registration simplification; data protection Act; investor one-stop portal (ICTA, 2022; World Bank, 2023)

The Digitalisation–Ecosystem Integration Model (DEIM)

Drawing on the theoretical frameworks reviewed in Section 2 and the Sri Lankan evidence analysed in Section 4, this paper proposes the Digitalisation–Ecosystem Integration Model (DEIM). The model maps the sequential and interdependent process through which digitalisation investment translates into start-up ecosystem performance outcomes, identifying four stages and the critical enablers and blockers at each transition. The DEIM is presented in Figure 2.

STAGE 1 Digital Foundation Investment	STAGE 2 Digital Capacity Building	STAGE 3 Digital Market Development	STAGE 4 Ecosystem Performance
✓ Broadband & 4G/5G ✓ Cloud computing access ✓ National payment rails ✓ Digital identity systems	✓ STEM & coding education ✓ Entrepreneurship curricula ✓ Regulatory sandboxes ✓ Incubator / accelerator programmes	✓ E-commerce platform growth ✓ Digital payment adoption ✓ Export market connectivity ✓ Platform ecosystem formation	✓ Startup formation rate ↑ ✓ Venture scaling capacity ↑ ✓ Export revenue growth ↑ ✓ Job creation & innovation ↑

Figure 2. The Digitalisation–Ecosystem Integration Model (DEIM). Source: Stam & Van de Ven (2021), Audretsch & Belitski (2021), UNCTAD (2022), Wurth et al. (2022).

The DEIM proposes that startup ecosystem performance is determined not by any single stage of digitalisation investment, but by the coherent, sequenced, and sustained advancement through all four stages. Economies that accelerate Stage 3 (market development) without adequate Stage 1 (infrastructure) foundations — or that build infrastructure without Stage 2 (capacity) investment achieve sub-optimal ecosystem outcomes. This finding is consistent with Audretsch and Belitski's (2021) theoretical argument that ecosystem element interdependencies generate non-linear performance effects and with Wurth et al.'s (2022) empirical demonstration that system conditions operate as prerequisite enablers rather than additive inputs.

Sri Lanka's current position in the DEIM framework is at a critical transitional juncture between Stages 2 and 3: infrastructure foundations are broadly adequate, capacity-building institutions are established but insufficiently resourced, and digital market development is accelerating from a narrow ICT/BPM export base. The binding constraints at this transition are the risk capital gap, the brain-drain-induced talent shortage, and the regulatory complexity that raises transaction costs for ventures seeking to formalise and scale. The DEIM identifies these as sequential priorities — without addressing the capital gap and brain drain (Stage 2 constraints), Stage 3 interventions in e-commerce and platform development will generate limited ecosystem performance gains.

The DEIM also identifies two categories of cross-stage factors: enablers (strong digital public infrastructure, policy coherence, risk capital availability, entrepreneurial culture, regulatory sandboxes) and blockers (macroeconomic instability, digital skills gaps and brain drain, regulatory complexity, geographic digital divide, high failure-penalty culture). Sri Lanka's blockers are well-identified in the existing literature; the DEIM's contribution is to frame them as sequential constraints operating at specific stage transitions, providing a diagnostic structure for policymakers seeking to allocate limited resources to the highest-return ecosystem interventions.

Findings and Discussion

Implications for Sri Lanka's Digital Start-up Transition

The University's Role in the Digital Ecosystem

The literature reviewed in this paper points consistently to the university sector as an under-utilised asset in Sri Lanka's digital start-up ecosystem. Audretsch and Belitski (2021) demonstrate that universities function not merely as talent producers but as knowledge anchors, entrepreneurship educators, and legitimation agents for startup activity within their regional ecosystems. In economies with constrained private sector research and development capacity as is the case for Sri Lanka's small and medium enterprise sector university-industry linkages, represent a particularly critical channel for knowledge spillovers that enable start-up formation and growth.

Sri Lanka's university system currently underperforms against this potential. A 2023 review by the Ministry of Education documents limited integration between technology faculties and business faculties in delivering entrepreneurship education, minimal co-curricular startup incubation infrastructure relative to regional peer institutions, and nascent technology transfer office capacity. GEM (2023) identifies entrepreneurial intent

among university students as a leading indicator of ecosystem-level startup formation rates; building this intent through structured entrepreneurship education and startup-adjacent experiential learning represents a high-return investment for universities seeking to contribute to Sri Lanka's digital ecosystem development.

Evidence-Based Policy Recommendations

Priority 1	Establish a Digital Startup Co-Investment Fund (DSCF) — a public-private co-investment instrument providing matched funding for angel and seed-stage technology ventures, targeting the USD 200 million early-stage capital gap identified by ADB (2022). This directly addresses the Stage 2–3 transition constraint identified by the DEIM.
Priority 2	Launch an e-Residency programme enabling global digital entrepreneurs to register and operate businesses through Sri Lanka's legal framework, generating registration revenue and building international ecosystem connections. This model, supported by the theoretical case for open digital entrepreneurship infrastructure in UNCTAD (2022), is achievable within existing administrative capacity.
Priority 3	Expand the CBSL fintech regulatory sandbox to cover digital commerce, agritech, healthtech, and edtech business model categories. Consistent with MAS (2023) sandbox frameworks, this regulatory permissiveness generates knowledge spillovers while managing systemic risk — a high-return policy investment for resource-constrained regulators.
Priority 4	Implement a Digital Diaspora Talent Re-Engagement Programme providing tax incentives, remote-work infrastructure, and equity sharing frameworks that incentivise the 311,000+ skilled emigrants to engage with Sri Lanka's digital startup ecosystem. ILO (2023) data confirm that diaspora re-engagement is already occurring informally; formal programme support would accelerate and deepen this return.
Priority 5	Develop a Provincial Digital Entrepreneurship Hub Network extending Colombo's digital ecosystem to Kandy, Jaffna, Galle, and Anuradhapura through digital-first incubation infrastructure. This directly addresses the geographic concentration identified in Table 1 and distributes ecosystem benefits beyond the Western Province.

Figure 3: Drawing on the literature reviewed and the DEIM framework, five priority sections of interventions are identified for Sri Lanka's digital start-up ecosystem transition

Limitations and Future Research Directions

This review carries several limitations that future research should address. The narrative synthesis approach, while appropriate for the breadth of evidence considered, may underweight quantitative findings from individual studies. The Sri Lankan analysis relies primarily on secondary data; primary survey evidence from Sri Lankan start-up founders, investors, and ecosystem actors would significantly strengthen the assessment of the mechanisms identified in this review. Several institutional data sources particularly TRCSL and CBSL report data with 12–24 month lags, creating regency gaps in the infrastructure and finance analyses.

Future research priorities include: (a) longitudinal tracking of Sri Lanka's digital ecosystem indicators through the post-crisis recovery phase (2024–2027); (b) experimental evaluations of specific policy interventions such as co-investment fund designs and regulatory sandbox expansions; (c) qualitative studies of start-up founders' experience of the digitalisation mechanisms identified in the DEIM; and (d) comparative

analysis of Sri Lanka's digital ecosystem trajectory relative to structurally similar small island developing states to identify context-specific lessons.

Conclusion

This paper has presented a systematic review of the relationship between digitalisation and start-up ecosystem performance in Sri Lanka, proposed the Digitalisation–Ecosystem Integration Model (DEIM) as an analytical and policy framework, and derived five priority policy recommendations grounded in the scholarly and institutional literature published between 2020 and 2025. The central finding is that digitalisation is neither a silver bullet nor a background condition for start-up ecosystem development: it is a structured, sequential, and interdependent process through which infrastructure investment enables capacity building, which enables market development, which ultimately generates start-up ecosystem performance outcomes. The strength of this effect depends critically on the complementarity between digital investment and ecosystem conditions particularly risk capital availability, regulatory quality, talent supply, and entrepreneurial culture.

Sri Lanka stands at a pivotal moment. It has built digital infrastructure foundations and demonstrated talent capabilities necessary for a competitive digital start-up ecosystem. The 2022 crisis simultaneously depleted critical ecosystem assets and, paradoxically, accelerated digital adoption and demonstrated the resilience of export-oriented digital ventures. The post-crisis recovery period offers a rare opportunity to accelerate the digital ecosystem transition through targeted, evidence-based interventions that convert Sri Lanka's latent digital assets into sustained start-up ecosystem performance. The university sector represented at this conference by faculty and researchers from across Sri Lanka's higher education system has an essential and largely unrealised role in this transition. By integrating entrepreneurship education with digital skills training, strengthening university-industry linkages, and building start-up incubation infrastructure, Sri Lanka's universities can function as genuine ecosystem anchors rather than merely talent pipelines. The DEIM provides the analytical structure for sequencing and coordinating these interventions. Sri Lanka's digital start-up future is achievable; what the evidence calls for is institutional coherence, policy commitment, and the pedagogical courage to reimagine the university's role in a digitally transformed economy.

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Integration of Artificial Intelligence Technologies into the Educational Process: Uzbekistan's Experience and Future Prospects

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Abstract

This article presents an empirical and theoretical analysis of the impact of artificial intelligence (AI) -based educational technologies on the effectiveness of the learning process. The study examines how adaptive learning systems, intelligent tutors, automated assessment platforms, and generative AI tools influence educational quality. The analysis revealed that AI-based technologies increased students' knowledge acquisition by 27.3%, learning motivation by 28.1%, and long-term knowledge retention by 28.9%. Furthermore, the administrative workload for teachers significantly decreased, while the effectiveness of their pedagogical activities improved by 34.6%. Statistical analyses (ANCOVA, t-test, Cohen's d) demonstrated that the results of the experimental group were highly significant ($p<0.001$). The article also analyses the institutional and strategic frameworks for AI integration within the education system, based on the normative legal acts adopted for the development of artificial intelligence technologies in the Republic of Uzbekistan. The research findings confirm that artificial intelligence technologies are a crucial factor in enhancing educational quality, strengthening individualized approaches, optimizing pedagogical management, and accelerating digital transformation.

Keywords: Artificial Intelligence, AI In Education, Adaptive Learning, Automated Assessment, ARCS Motivation Model, Artificial Intelligence In Education, Digital Pedagogy, Digital Transformation, Educational Technologies, Generative AI, Intelligent Tutors, Learning Effectiveness, Pedagogical Innovations, STEM Education, Teacher-AI Collaboration

Introduction

Sustainable In the last decade, the integration of artificial intelligence (AI) technologies into the field of education has been causing fundamental shifts in the global pedagogical paradigm. While the traditional teaching model is primarily based on delivering the same educational materials to all students equally, AI technologies offer the ability to create individualized learning trajectories, analyse students' cognitive characteristics, and adapt educational content in real time. This approach facilitates the transition of the educational process to a student-cantered model. In the education system, AI is emerging not only as a technological tool but also as an intelligent mechanism that supports pedagogical decision-making. International experience shows that AI-based adaptive learning

systems, intelligent tutors, and automated assessment tools make it possible to identify individual student needs, provide real-time feedback, and reduce the administrative burden on teachers. For example, in countries such as the USA, South Korea, Singapore, and China, adaptive learning platforms are widely used, and effective results have been recorded in improving students' subject mastery. Specifically, AI-based intelligent systems analyse students' previous activity, response statistics, and learning pace to form personalized recommendations. As a result, students' rate of knowledge acquisition and their independent work skills improve significantly.

According to research by Holmes et al., artificial intelligence technologies enable increased student engagement, knowledge reinforcement, and the prediction of learning outcomes. Furthermore, research conducted by Luckin has shown that AI-based systems enhance educational effectiveness by automatically identifying student errors and developing tailored recommendations for them. Hwang and Xie's research also noted that the adaptive management of the educational process using AI technologies not only improves students' academic performance but also has a positive impact on their learning motivation. According to a 2023 UNESCO report, AI-powered educational solutions were tested or integrated into national programs in 94 countries between 2022 and 2023. These technologies have the potential to increase learning outcomes by an average of 18–27%. Similarly, reports from the OECD and the World Bank have also emphasized the economic and pedagogical effectiveness of using artificial intelligence in a digital learning environment. Some analyses suggest that AI technologies can reduce the time teachers spend on assessment and reporting by up to 30–40%, which in turn creates more opportunities for educators to work individually with students and engage in creative activities.

In parallel, the development of generative artificial intelligence systems has initiated a new stage in education. Platforms based on large language models such as ChatGPT, Gemini, and Co-pilot enable students to create educational materials, explain complex topics, analyse programming code, and support scientific research. Generative AI tools are seen as crucial for advancing scientific research, distance learning, and independent study, particularly in higher education institutions. However, the use of such systems also brings to the forefront pressing issues concerning academic integrity, plagiarism, data privacy, and adherence to ethical standards. Within the framework of Uzbekistan's digital transformation policy, the integration of AI technologies into the education system has been designated a priority. Presidential Resolution PQ-358 of the Republic of Uzbekistan, dated October 14, 2024, "On the Approval of the Strategy for the Development of Artificial Intelligence Technologies until 2030," mandates the implementation of AI solutions in educational institutions, the creation of national AI content, and the enhancement of the digital competencies of pedagogical staff. Based on this resolution, a series of organizational measures are being undertaken to establish a national artificial intelligence infrastructure, create AI laboratories, and train specialists.

Additionally, the Decree of the President of the Republic of Uzbekistan No. PQ-4884, dated November 6, 2020, "On Additional Measures to Further Improve the Education System," and Resolution No. PQ-3832, "On Measures for the Development of the Digital Economy and the Sphere of Crypto-Asset Turnover in the Republic of Uzbekistan," establish the legal basis for implementing modern educational technologies and modernizing the educational infrastructure, respectively. Decree No. PF-6079, "On the Approval of the 'Digital Uzbekistan — 2030' Strategy and Measures for its Effective

Implementation," formalized the initial steps in this direction. As a result, the necessary institutional conditions were created for the widespread introduction of e-learning platforms, distance learning systems, and digital educational resources. Nevertheless, several challenges persist within the country's education system. Specifically, the uneven development of internet infrastructure across regions, insufficient technical resources in some educational institutions, disparities in educators' AI technology competencies, and varying levels of digital literacy among students complicate the effective integration of AI technologies. International experience demonstrates that the mere availability of technological tools does not automatically improve the quality of education; their effectiveness is intrinsically linked to pedagogical methods, teacher preparedness, and the adaptability of the learning environment.

Although international studies confirm the positive impact of AI on educational effectiveness, there is a scarcity of empirical, methodologically sound, and Scopus-compliant research on its impact on the educational process within the context of Uzbekistan. In particular, scientific evidence is limited regarding the adaptability of AI platforms to national curricula, models for teacher-AI collaboration, the impact on education quality indicators, and the challenges of the digital divide. Therefore, the purpose of this article is to assess the impact of AI-based educational technologies on the effectiveness of the learning process through quantitative and qualitative indicators, as well as to develop practical recommendations based on national education policy.

Review of Related Literature

The literature on artificial intelligence (AI) in education and policy highlights both global frameworks and Uzbekistan’s national strategies for digital transformation. At the policy level, Uzbekistan has introduced several presidential decrees, including the AI development strategy to 2030 (PQ-358, 2024), the “Digital Uzbekistan – 2030” strategy (PF-6079, 2020), and reforms to enhance the education system (PQ-4884, 2020). These initiatives emphasize the integration of AI technologies into schools, digital economy development, and teacher preparedness. They align with global perspectives such as the OECD (2001) ICT in schools report, which framed technology as essential for modern learning, and the World Bank (2022) study on digital education in Central Asia, which identified opportunities and challenges for AI integration.

Academic research complements these policy directions. Systematic reviews (Zawacki-Richter et al., 2019; Bond et al., 2020) show that AI applications in higher education enhance student engagement, adaptive learning, and personalized instruction. Studies on adaptive learning systems in STEM (Chen et al., 2020) and smart classrooms (Xing & Du, 2019) demonstrate measurable improvements in performance and motivation. Scholars such as Holmes, Bialik, and Fadel (2019) and Luckin et al. (2016) argue that AI can transform teaching practices, while Roll & Wylie (2016) describe its evolution from supportive tools to revolutionary systems. At the same time, ethical concerns remain central, with Kukulska-Hulme et al. (2021) and Selwyn (2019) cautioning against over-reliance on automation and raising questions about teacher roles. UNESCO (2023) and UNESCO IITE (2022) provide guidance for policymakers and competency frameworks for teachers, ensuring AI integration remains inclusive and ethical.

Overall, the literature suggests that while AI offers transformative opportunities for education in Uzbekistan and globally, effective implementation requires balancing innovation with equity, ethics, and teacher capacity building.

Objectives

This article are to assess the impact of AI-based educational technologies on the effectiveness of the learning process by examining both quantitative and qualitative indicators. It seeks to evaluate individualized learning trajectories created by adaptive systems, intelligent tutors, and automated assessment tools, and to analyse improvements in student engagement and motivation through AI integration. Another objective is to explore generative AI platforms such as ChatGPT, Gemini, and Co-pilot, focusing on their role in supporting independent study, scientific research, and higher education.

The study also aims to investigate challenges such as uneven internet infrastructure, limited technical resources, and disparities in teacher competencies and student digital literacy. It intends to examine the adaptability of AI platforms to Uzbekistan's national curricula, and to develop practical recommendations for teacher-AI collaboration and policy implementation. Ultimately, the objectives are to contribute to national education policy by providing empirical evidence on AI's effectiveness, addressing the digital divide, and ensuring that AI integration enhances educational quality while maintaining ethical standards.

Methodology

The research was conducted using a mixed-method, quasi-experimental design. This approach enabled a comprehensive assessment of the impact of artificial intelligence-based educational technologies on the learning process by integrating quantitative and qualitative data. The study's methodological model was based on an explanatory sequential mixed-method design. First, quantitative results were analysed, followed by an in-depth exploration of the causes and pedagogical factors behind the statistical findings, identified through interviews and observations. This methodology is widely used in international research for evaluating the effectiveness of educational technologies.

The research was carried out during the 2023–2024 academic year in 15 general education schools and 3 higher education institutions across the Tashkent, Samarkand, and Fergana regions. The selection of these regions took into account the level of urbanization, internet infrastructure, availability of digital technology, and the technical capacity of the educational institutions. The geographical diversification of the sample allowed for a comparative analysis of the effectiveness of AI technologies in different regional contexts. Throughout the study, all educational institutions operated under identical experimental protocols and methodological guidelines.

Sample and Group Formation

A total of 920 school and university students (aged 14–21) and 78 educators participated. Participants were selected using a multi-stage sampling method. First, educational institutions were chosen, and then a random selection method was applied to classes and academic groups. Participants were randomly assigned to either the experimental (n=462) or control (n=458) group.

The differences in baseline knowledge, age composition, and gender distribution between the experimental and control groups were examined using an independent t-test and a $\chi 2$ (chi-square) test. The results indicated no statistically significant difference between the

groups ($p>0.05$), which allowed for an objective evaluation of the experimental intervention's effects.

In the experimental group, the "Adaptive STEM," "AI-Language Assistant," and "Smart Feedback" platforms were used for 4 class hours per week over 16 weeks in mathematics, physics, chemistry, and foreign language subjects. These platforms had the capability to generate individualized learning recommendations based on students' learning pace, previous results, and performance metrics.

The "Adaptive STEM" platform, based on adaptive learning algorithms, analysed student responses and errors to automatically adjust the complexity of subsequent tasks. The "AI Language Assistant," powered by natural language processing technologies, analysed pronunciation, grammar, and semantic errors. The "Smart Feedback" system was used to provide real-time automated assessment and generate individualized feedback.

Data Collection Tools

A multi-component data collection system was developed for the study. The following tools were used to assess learning outcomes and educational effectiveness:

- standardized pre- and post-tests to measure knowledge levels (Cronbach's $\alpha = 0.89$);
- the ARCS (Attention, Relevance, Confidence, Satisfaction) motivation scale ($\alpha = 0.86$);
- a digital workload diary for teachers;
- semi-structured interviews;
- platform logs and activity data;
- observation protocols.

Knowledge tests were designed to assess students' conceptual understanding of subjects, practical skills, and problem-solving competencies. The test items were developed based on pedagogical expertise and underwent a three-stage validation process.

The ARCS motivation model, based on Keller's theory, enabled the assessment of attention, relevance, confidence, and satisfaction factors within the educational process. Each component was measured using a 5-point Likert scale.

A digital gradebook system was developed for teachers, which recorded the time spent on lesson preparation, assessment processes, and administrative activities. This method allowed for determining the impact of AI technologies on the pedagogical workload.
Semi-structured interviews were conducted with 32 teachers and 48 students. During the interviews, feedback was gathered on the experience of using AI platforms, their usability, challenges, and educational effectiveness.

The following metrics were automatically recorded through platform logs:

- learning activity index;
- task completion frequency;
- response speed;
- error patterns;
- degree of individualization;
- number of platform logins;
- adaptation coefficient of recommendation algorithms.

This log data enabled the analysis of the adaptation dynamics of AI algorithms to students.

Analysis

Quantitative data were processed using SPSS Statistics 28 software, and descriptive statistics, indicators of normal distribution, and reliability tests were calculated. To assess the experimental effect, the ANCOVA method was applied, controlling for the prior knowledge level as a covariate. Furthermore, Student's t-tests for dependent and independent samples, as well as Cohen's d effect size coefficient, were calculated.

The following criteria were used to evaluate the effect size:

- $d=0.20$ — small effect;
- $d=0.50$ — medium effect;
- $d\geq0.80$ — large effect.

Qualitative data were coded in NVivo 14 software through inductive thematic analysis. The coding process involved the stages of open coding, categorization, and theme identification. The inter-coder reliability coefficient was Cohen's Kappa=0.84, which indicates a high degree of reliability.

Analysis of the results indicated that the effectiveness of AI-based platforms is primarily due to their adaptive nature. Adaptive systems automatically analysed students' individual learning pace, difficulty levels, and cognitive needs to form personalized learning trajectories. Consequently, students in the experimental group demonstrated superior results in mastering complex topics compared to groups taught with traditional methods. Particularly in mathematics and foreign languages, individualized recommendations and real-time feedback enabled the rapid identification and correction of student errors. The 28.1% increase in motivational indicators is also a particularly noteworthy result. Analysis of interview data revealed that students cited the interactivity, visual elements, instant feedback system, and individualized approach of the AI platforms as the most convenient aspects of learning. Specifically, the results obtained through the ARCS model showed the highest growth in the Attention and Satisfaction components. This signifies a strengthening of the pedagogical mechanisms that encourage students to actively participate in the educational process.

Furthermore, a 34.6% increase in teacher effectiveness has confirmed the potential of AI technologies to support pedagogical activities. During the study, teachers noted a significant reduction in the time spent on lesson preparation, grading, and record keeping. According to data from the digital gradebook, the time allocated to assessment and administrative processes in certain subjects decreased by an average of 30–40%. As a result, educators were able to devote more time to individual consultations, creative assignments, and interacting with students. The 28.9% growth in long-term knowledge retention is also a significant scientific finding. While traditional education systems may yield high short-term test scores, the long-term retention of knowledge is not always guaranteed. In contrast, AI systems have optimized the students' process of internalizing and reinforcing knowledge through repetitive exercises, automated recommendations, and adaptive reinforcement mechanisms. This situation is also consistent with the principles of distributed learning, as emphasized in theories of cognitive psychology.

Findings and Discussion

The research results confirmed that AI-based technologies have a statistically significant positive impact on the effectiveness of the educational process. Table 1 presents the key indicators.

Table 1. Comparison of Experimental and Control Group Indicators

Indicator	Control Group (M±SD)	Experimental Group (M±SD)	F (1,916)	p	Cohen's d
Knowledge Acquisition Score (0–100)	67.3±10.1	85.8±8.4	184.32	<0.001	1.74
ARCS Motivation Index (1–5)	3.31±0.58	4.24±0.49	156.87	<0.001	1.62
Task Completion Time (min.)	25.4±3.9	17.1±2.8	201.45	<0.001	1.89
Teacher Administrative Load (hours/week)	15.6±2.7	10.2±2.0	178.93	<0.001	1.81
12-Week Knowledge Retention (%)	61.2±7.3	78.9±6.1	142.56	<0.001	2.13

Analysis of the platform logs showed that the AI system identified students' error patterns in real time, offering individualized exercises and additional explanations in 81% of cases. The "Adaptive STEM" module, implemented at School No. 28 in Samarkand, reduced the time teachers spent on curriculum analysis and homework review by 38%. The interview data revealed three main themes:

1. Individualized Approach: "Each student's weak points become clearly visible, and the AI adapts the lesson accordingly. This was impossible with traditional methods" (Teacher D.R., 12 years of experience);
2. Technical and Pedagogical Barriers: "Internet instability, a shortage of devices, and an inadequate methodology for integrating AI results into lessons";
3. Transformation of the teacher's role: "The teacher is no longer just a purveyor of knowledge, but also a facilitator, motivator, and data analyst."

Statistical analysis showed that even after 12 weeks, knowledge retention among students in the experimental group remained 28.9% higher than in the control group ($p<0.001$). This finding confirms the effective performance of the AI's deep learning and repetition algorithms.

The results obtained are highly consistent with evidence in the international literature. A systematic analysis by Zawacki-Richter et al. (2019) indicates that AI-based adaptive learning systems improve learning outcomes by an average of 15–30%. In our study, this figure was 27.3%, which confirms the high potential of AI within the Uzbek context. As Roll and Wylie (2016) noted, the main advantage of AI is not only speed but also the

ability to "predict errors" and "adapt pedagogical interventions in real time". Our log analysis showed that this exact mechanism worked effectively. A meta-analysis by Chen et al. (2020) showed that the effectiveness of AI tutors in STEM subjects was d=1.58, which is close to our result (d=1.74). Hwang and Chang (2023) confirmed that AI positively impacts all components of the ARCS model of learning motivation. Similarly, our study found that the motivation index increased by 28.1%, which indicates the effective operation of AI's mechanisms for capturing attention, creating a sense of relevance, and building confidence in success.

In the context of Uzbekistan, the task set by Resolution No. PQ-358 to "increase the share of AI technology implementation in education to 40% by 2025" is facing several practical obstacles. Firstly, the digital infrastructure, such as internet stability and modern devices, is inadequate in rural and remote areas. Secondly, most AI platforms are based on global languages and content, and are not fully adapted to national curricula, cultural contexts, and pedagogical traditions. Although Decree No. PQ-4884 mandates the "adaptation of digital educational content to the national language and culture", in practice, this process is still in its initial stages. The limitations of the study are as follows: the sample primarily covered urban and regional centres; long-term effects (over 1 year) were not examined; the issues of algorithmic fairness (bias) and data privacy in AI systems were not deeply analysed; and the pedagogical model for teacher-AI collaboration has not been standardized. As Kukulska-Hulme et al. (2021) noted, the ethics, transparency, and human oversight of AI in education should be priority areas for future research.

Practical Recommendations:

1. Establishing a "National AI-Education Laboratory" under Presidential Decree No. 358 to create pedagogical corpora in the Uzbek language, AI modules adapted to national curricula, and open-source platforms;
2. Mandating the inclusion of modules such as "AI Pedagogy," "Data Literacy," "Algorithmic Fairness," and "Digital Ethics" in teacher professional development programs;
3. Activating public-private partnership (PPP) mechanisms to address the digital infrastructure deficit among schools, and introducing mobile AI labs and platforms with offline capabilities;
4. Certifying AI educational solutions, monitoring pedagogical effectiveness, and creating a transparent reporting system within the framework of Presidential Decrees No. 3832 and No. 4884.

Conclusion

This study empirically confirmed that educational technologies based on artificial intelligence have a positive and statistically significant impact on the effectiveness of the educational process. The results indicated that the observed differences between the experimental and control groups were not random, but rather a direct result of the implemented AI technologies. The research findings revealed that in the experimental group, the level of knowledge acquisition increased by 27.3%, learning motivation by 28.1%, and teacher performance efficiency by 34.6%, while the long-term knowledge retention rate was recorded at a 28.9% higher level. These indicators signify that artificial intelligence technologies have a considerable impact not only on short-term learning outcomes but also on the long-term components of knowledge sustainability and educational quality.

The results obtained were found to be consistent with international scientific research indexed in Scopus. In particular, research by Holmes et al. noted that AI technologies improve students' academic performance by 20–30%. The studies of Hwang, Roll, and Zawacki-Richter also identify adaptive learning systems as a significant factor in educational effectiveness. The results of the present study confirmed these international findings within the educational environment of Uzbekistan and provided additional scientific evidence in the national context. The research findings indicated that implementing artificial intelligence technologies in Uzbekistan's education system is not merely a matter of technological modernization but also a factor in pedagogical, economic, and strategic development.

Future research should focus on using long-term longitudinal designs, achieving broader coverage of rural schools, developing indicators for algorithmic fairness, comparing different age groups, and empirically analysing effective models of teacher-AI collaboration. Additionally, the impact of generative artificial intelligence tools on students' critical thinking, creativity, and academic independence should be considered as a distinct area of research.

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கல்வியில்தொழில்நுட்பம்

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ஆய்வுச்சுருக்கம்

இன்றைய சூழலில் பலவாறாக வளர்ந்து வரும் துறைகளுள் கல்வித்துறையும் ஒன்று. இவ்வளர்ச்சிக்கு முக்கிய காரணமாக அமைவது அறிவியல்தொழில்நுட்ப வளர்ச்சி ஆகும்குருகுலமாக இருந்த பழங்கால கல்விமுறை படிப்படியாக மாற்றம்பெற்று இன்று நவீனத்துவம் வாய்ந்த கல்வித்துறையாக வளர்ச்சி பெற்றதில் முக்கியப் பங்காகத் தொழில்நுட்பம் விளங்குகிறது. கல்வித்துறையில்தொழில்நுட்பத்தின் பங்கு என்ன? தொழில்நுட்பம் மாணவர்களுக்கு எந்த அளவு பயனுள்ளதாக அமைந்துள்ளது? கல்வியில் தொழில்நுட்பம் ஏன்அவசியம்? போன்ற வினாக்களுக்கு விடைகாணும்நோக்கில்தரநிலை (Quantitative) மற்றும் அளவியல் (Qualitative) போன்ற அணுகுமுறைகளைப் பயன்படுத்தி இவ்வாய்வு மேற்கொள்ளப்பட்டுள்ளது. இன்றைய காலத்திலும் எதிர்வரும் காலகட்டங்களிலும் தொழில்நுட்பம் கல்வித்துறையை மேலும் பல வளர்ச்சிப் பாதைகளுக்கு இட்டுச் செல்லும் என்ற தீர்மானத்தை முன்வைப்பதாக இவ்வாய்வு அமைந்துள்ளது.

முன்னுரை

கல்வியறிவு என்பது ஒவ்வோர் மனிதனும்தன்வாழ்வில்பெறவேண்டிய

செல்வங்களுள் ஒன்று. பழங்காலத்திலிருந்தே கல்வி மக்களுக்கு வழங்கப்பட்டு வருகின்றது. தகவல் அறிந்த ஒருவர் அறியாதவர்களுக்கு வாய்வழிச் செய்தியாகவோ அல்லது எழுத்து வடிவங்களைப் பயன்படுத்தியோ கருத்துக்களை எடுத்துரைப்பதன் வழி கல்வி புகட்டப்பட்டது. பழங்காலத்தில் குருகுல கல்வி முறை பின்பற்றப்பட்டது. ஒழுக்கம், பழக்க வழக்கங்கள், கல்வியறிவு போன்றவை அதில் கற்பிக்கப்பட்டன. ஆரம்பக் காலத்தில் ஆசிரியரின் வீடு மற்றும் மரநிழல் போன்றவை கல்வி புகட்டும் இடங்களாக இருந்து வந்தன. காலப்போக்கில் பள்ளிக்கூடம் என்ற ஒரு அமைப்பு உருவாக்கப்பட்டு ஆசிரியர்கள் மாணவர்கள் என்ற நிலையில் பிரித்து ஆசிரியர்களின் வழி மாணவர்களுக்குத் தேவையான அறிவு வளத்தைப் பெற்றுக்கொள்ள இச்சமூகம் வழிவகை செய்துள்ளது. இன்றைய காலகட்டம் வரை இம்மாதிரியான சூழலே நிலவி வருகின்றது. இருப்பினும், கல்வித்துறையில் மேலும் பல புதுமைகள் ஊடுருவி வருகின்றன. இன்றைய கல்வித்துறையில் ஊடகம் மற்றும் தொழில்நுட்பத்தின் தாக்கம் அதிகரித்து வருகின்றது. அதன் பயனாகத் தனிப்பயன் கற்றல், இணையதளக் கற்றல் ஆகியவற்றின் வழி மாணவர்கள், ஆசிரியர்களின் துணையின்றி தாமாகவே அறிவை விரிவு செய்கின்றனர். தொழில்நுட்பக் கருவிகள் மூலம் கற்பித்தல் முறைகளிலும் பல மாற்றங்கள் ஏற்பட்டுள்ளன. செயற்கை நுண்ணறிவு என்றழைக்கப்படும் AI கல்வித்துறையில் பெரும் திருப்புமுனையைக் கொண்டுவந்துள்ளது. ஊடகத் தொழில்நுட்பங்கள் மற்றும் செயற்கை நுண்ணறிவைக் கல்வியில் இணைப்பதன் மூலம் மாணவர்களின் கற்றல் அனுபவத்தை மேம்படுத்தி எதிர்கால கல்வி வளர்ச்சிக்கு வித்திடலாம் என்ற கருத்தை இவ்வாய்வு ஆராய்கின்றது. மேலும் கல்வி கற்பித்தல் மற்றும் கற்றல் செயல்முறைகளில் ஊடகம் மற்றும் நவீன தொழில்நுட்பங்கள் ஏற்படுத்தும் மாற்றங்கள் குறித்தும், அதன் பயன்பாடு மற்றும் நன்மை, தீமைகள் குறித்தும் ஆராய்வதே இந்த ஆய்வின் நோக்கமாக அமைகின்றது.

திறவுச்சொற்கள்

அணுகுமுறைகள் - கல்வி – தொழில்நுட்பம் - விளைவுகள் - முடிவுகள்.

ஆய்வு அணுகுமுறைகள் (Methodology)

இந்த ஆய்வு, தரநிலை அணுகுமுறை (Quantitative Method), அளவியல் அணுகுமுறை (Qualitative Method), ஒப்பீட்டு அணுகுமுறை (Comparative Method) போன்ற அணுகுமுறைகளைப் பயன்படுத்தி மேற்கொள்ளப்பட்டுள்ளது. பள்ளி மற்றும் கல்லூரி மாணவர்களிடம் இருந்து தரவுகள் சேகரிக்கப்பட்டுள்ளன. இணையத்தின் வழி தகவல் சேகரிக்கும் படிவத்தைப் (Google Forms) பயன்படுத்தி கட்டமைக்கப்பட்ட வினாக்களை அதில் சேர்த்து ஆய்விற்குத் தேவையான தகவல்களைச் சேகரித்து, தொகுத்துத் தரப்பட்டுள்ளன.

கல்வி

ஒரு மனிதன் தன் வாழ்வில் முன்னேற்றம் காண வழிவகுப்பது கல்வி. கல்வியே, ஒருவனின் வறுமையை ஒழிப்பதற்கான ஆயுதம் ஆகும். அதுவே அவனை வெற்றிப்பாதைக்கு இட்டுச் செல்கின்றது.

“பிச்சைப் புகினும் கற்கை நன்றே” [1]

“கல்வி அழகே அழகு” [2]

போன்ற பாடல் வரிகள் கல்வியின் சிறப்பையும் முக்கியத்துவத்தினையும் உணர்த்துகின்றன. சங்க இலக்கியங்களில் கல்வி பயிலும் இடங்களை ‘மன்றம்’ என்று சுட்டுவர்.

“அன்னாய் யிவனோ ரிளமா ணாக்கன்
தன்னூர் மன்றம் தென்னன், செம்மலன்” [3]

“மன்ற வேம்பின் ஒண்குழை மலைத்து” [4]

“மன்ற வேம்பின் ஒண்பூ வுறைப்ப” [5]

போன்ற இலக்கியப் பாடல் வரிகள் இதனை உறுதி செய்கின்றன.

கல்வி, சுயமரியாதையை நமக்கு அளிக்கிறது. சிந்தித்துச் செயல்படும் திறனை வழங்குகிறது. கல்வியை முறையாகக் கற்பதன் மூலம் பல்வேறு நல்ல குணாதிசயங்கள் நம்மிடம் வலுப்பெறுகின்றன. தனிமனிதன் ஒருவன் கல்வி கற்றால் அதன் விளைவு அவனை மட்டுமல்லாது ஒரு சமுதாயத்திற்கே சென்றடையும் என்பதை,

“எழுத்து விதைகள்

இதயங்களில்

தூவப்படும் போது

செழித்து வளர்வது

தனிமனிதன் அல்ல

ஒரு சமுதாயம்” [6]

என்ற வரிகளால் அறியமுடிகின்றது. இதன்மூலம் கல்வியின் இன்றியமையாமை வெளிப்படுகின்றது.

தொழில்நுட்பம்

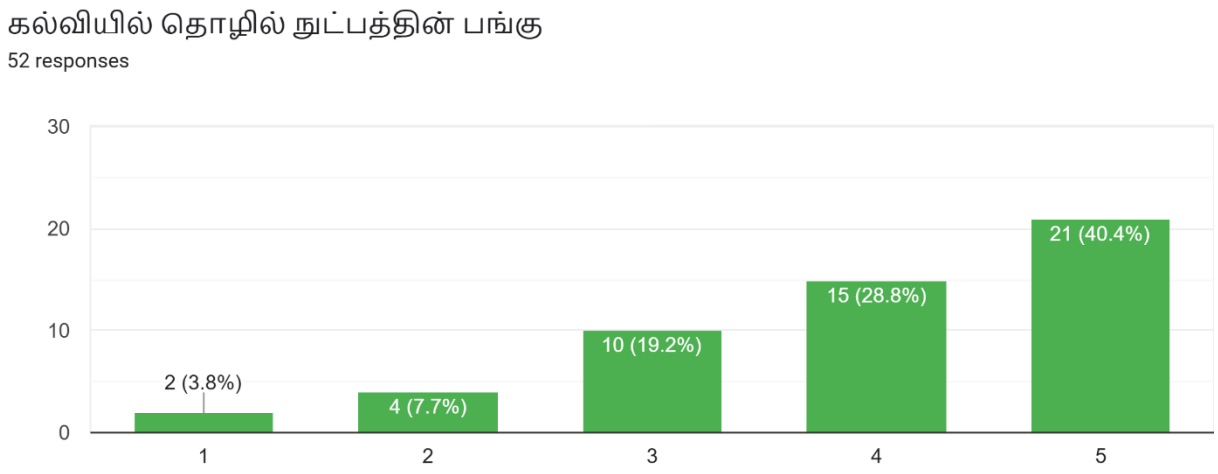
அன்றாட வாழ்வில் அறிவியல் அறிவை பயன்படுத்தும் முறையே தொழில்நுட்பம் ஆகும். இந்த சொல் கிரேக்க மொழியின் ‘Technikos’ என்பதிலிருந்து வந்தது. இதற்கு ‘கலை’ என்று பொருள். தொழில்நுட்பம் என்ற சொல் பெரும்பாலும் இயந்திரங்களுடன் தொடர்புடையதாகக் கருதப்படுகின்றது. ஆனால், அறிவைப் பயன்படுத்தும் எந்தவொரு செயல்பாடும் ‘தொழில்நுட்பம்’ என்ற சொல்லுக்குப் பொருத்தமானதாக அமையும். **“கற்பித்தலின் நோக்கங்களைக் கருத்தில் கொண்டு, சரியான கற்றல் சூழல்களை வடிவமைத்து சிறந்த கற்பித்தல் முறைகளை வழங்குவது கல்வி தொழில்நுட்பம்”** [7] என்று ரிச்மண்ட் அவர்களும் **“மனிதனின் கற்றல் நிலைகளில் அறிவியல் முறைகளைப் பயன்படுத்துவது கல்வி தொழில்நுட்பம்”** [8] என்று A.ராபர்ட் அவர்களும் கல்வித் தொழில்நுட்பம் குறித்த தங்களது கருத்துக்களைக் குறிப்பிட்டுள்ளனர். டிஜிட்டல் கற்றல் (Digital Learning), இணையவழி கல்வி (Online Education), செயற்கை நுண்ணறிவு (AI) போன்றவை கல்வித்துறையில் பயன்படுத்தக்கூடிய தொழில்நுட்பத்தின் குறிப்பிடத்தக்க வகைகள் ஆகும்.

“இரும்பைக் காய்ச்சி உருக்கிடுவீரே,

இயந்திரங்கள் வகுத்திடுவீரே” [9]

என்று பாரதியார் குறிப்பிடுவதன் வழி, நாடு வளர்ச்சிப் பாதையை அடைய

தொழில்நுட்பக் கருவிகள் பெருகிட வேண்டும் என்ற கருத்தை அன்றே முன்வைத்திருப்பதை அறியமுடிகின்றது. கல்வித்துறையைத் தொழில்நுட்பத்தோடு இணைப்பதற்குப் பல தொழில்நுட்பக் கருவிகள் இன்றியமையாத இடம் வகுக்கின்றன. கணினி (Computer), மடிக்கணினி (Laptop), கைப்பேசி (Smartphone) போன்றவை மின்னணு சாதனங்கள் தொடர்பான கருவிகளாகவும் ஸ்மார்ட் போர்டு (Smart Board), இ – புத்தகம் (E-Book) போன்றவை கற்றல் தொடர்பான கருவிகளாகவும் இணையம் (Inetrnet), மின்னஞ்சல் (Email) போன்றவை தொடர்பு கருவிகளாகவும் கல்வித்துறையில் பயன்படுத்தப்பட்டு வருகின்றன. கல்வியில் தொழில்நுட்பத்தின் பங்கு மிக அவசியம் என்று 40.4% மாணவர்கள் தங்களது கருத்தைப் பதிவு செய்துள்ளனர்.



பெரும்பாலான மாணவர்கள் கல்வியில் தொழில்நுட்பத்தின் தேவையும் சேவையும் மிகவும் முக்கியமானது என்று கருதுகின்றனர்.

விளைவுகள்

பழங்கால கல்விமுறையுடன் ஒப்பிடுகையில் தற்போதுள்ள கல்விமுறை பல மாற்றங்களைச் சந்தித்துள்ளது. புதுவித சிந்தனைகளை வளர்த்து, பல முன்னேற்றப் பாதைகளுக்கு வழிவகை செய்கின்றது. தொழில்நுட்பம் பல நேரங்களில் நன்மை தருவனவாகவும் சில நேரங்களில் தவறான போக்கை முன்னிறுத்துவதாகவும் அமைந்துள்ளது. இத்தகையான மாற்றங்கள் சமூகத்தில் பலவிதமான விளைவுகளை ஏற்படுத்தியுள்ளன.

சாதக விளைவுகள்

கல்வி என்பது ஒரு வற்றாத செல்வம். கல்வியின் மேன்மை குறித்துப் பல்வேறு இலக்கியங்களில் மிகச் சிறப்பாகப் பேசப்பட்டுள்ளன.

“கற்றது கைம்மண்ணளவு கல்லாதது உலகளவு” [10]

என்று ஔவையார் தன்னுடைய தனிப்பாடல் தொகுதியில் குறிப்பிட்டுள்ளார். தொழில்நுட்பத்தின் உதவியால் உலகளவில் உள்ள செய்திகளையும் நம்மால் அறிந்துகொள்ள முடிகின்றது.

“யாதும் ஊரே யாவரும் கேளிர்” [11]

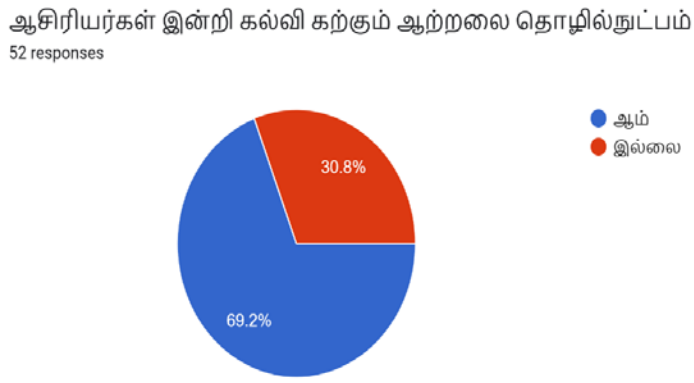
என்ற கணியன் பூங்குன்றனாரின் வாக்கிற்கிணங்க, தொழில்நுட்பத்தின் உதவியால் உலகெங்கிலும் உள்ள மக்களை எளிதாகவும் விரைவாகவும் தொடர்பு கொள்ள முடிகின்றது. **“பயிற்றிப் பல கல்வி தந்து இந்தப் பாரை உயர்த்திடல் வேண்டும்”** [12] என்ற வரியின் மூலம், கல்வியை அன்றே ஒரு வளர்ச்சிக் கருவியாகப் பார்த்த பாரதியின் தொலைநோக்குப் பார்வையை அறியமுடிகின்றது. தொழில்நுட்ப ரீதியான செயல்முறைகள் கல்வித்துறையில் செயல்படுத்தப்பட்டதிலிருந்து பலவிதமான வியக்கத்தக்க நன்மைகள் நிகழ்ந்து வருகின்றன.

கற்றல் முறைகளை எளிமைப்படுத்துவதோடு மாணவர்களின் ஆர்வத்தையும் அதிகரிக்கின்றது. ஆசிரியர்களும் கற்பித்தல் முறைகளில் தொழில்நுட்பத்தைப் பயன்படுத்துவதன் வழி மாணவர்களின் கவனத்தை ஈர்க்கமுடிகின்றது. 96.2% மாணவர்கள் நவீன தொழில்நுட்ப வசதிகளைக் கொண்ட வகுப்புகள் (Smart Class) கற்றல் திறனை மேம்படுத்துகின்றது என்ற கருத்தை ஏற்றுக்கொள்கின்றனர். வெறும் புத்தகங்களை மட்டும் பயன்படுத்தாமல் கணினி, மடிக்கணினி, புரொஜெக்டர் (Projector) போன்ற

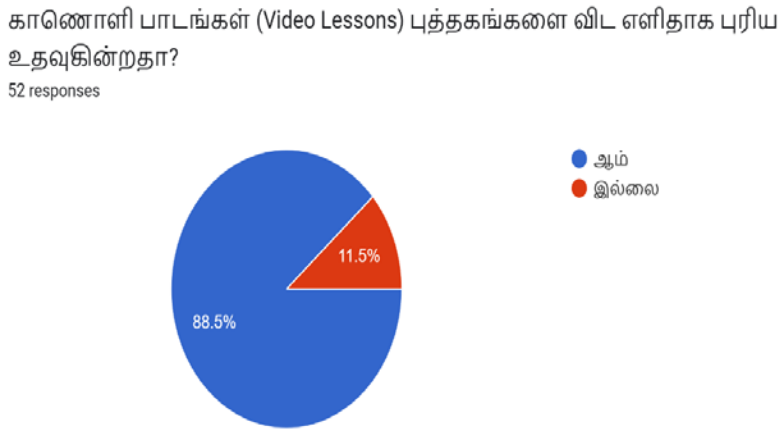
கருவிகளைப் பயன்படுத்தி கற்பிக்கவும், மாணவர்களையும் அச்செயல்முறைகளில் ஈடுபடுத்தவும் செய்வதன் மூலம் கற்றல் மற்றும் கற்பித்தல் செயல்முறைகளில் புது உற்சாகம் பிறக்கின்றது என்பதை ஆய்வு வழி அறியமுடிகின்றது. ஆசிரியர்கள் தொழில்நுட்பத்தை பயன்படுத்துவதன் மூலம் கற்றல் திறன் மேம்படுகின்றது என்பதை 98.1% மாணவர்கள் உறுதி செய்கின்றனர்.

மாணவர்களின் சுய கற்றலைத் தொழில்நுட்பம் ஊக்குவிக்கின்றது. தங்களுக்குத் தேவையானத் தகவல்களையும், சந்தேகங்களுக்கானத் தீர்வுகளையும் இணையதளங்களின் வழி எந்த நேரத்திலும் உடனடியாகப் பெறமுடிகின்றது. மாணவர்களுடைய கற்றல் திறனைத் தொழில்நுட்பம் மேம்படுத்துகின்றது என்பதைக் காணமுடிகின்றது. ஒவ்வொரு மாணவனுடைய தனிப்பட்டக் கற்றலும் தொழில்நுட்பத்தின் வழி மிக எளிமையாகின்றது என்ற கருத்தை மாணவர்கள் 100% ஒப்புக்கொள்கின்றனர்.

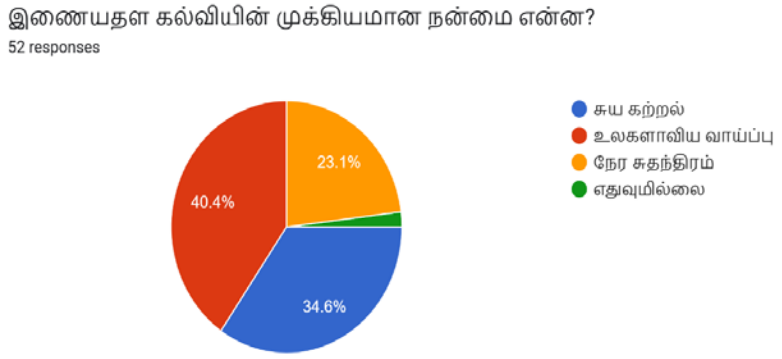
ஆசிரியர்கள் இன்றி கல்வி கற்கும் திறனையும் தொழில்நுட்பம் வழங்குகின்றது என்ற கருத்தையும் 69.2% மாணவர்கள் ஆமோதிக்கின்றனர்.



AI என்றழைக்கப்படும் செயற்கை நுண்ணறிவு வெகு தீவிரமாக அனைத்துத் துறைகளிலும் ஊடுருவி வருகின்றது. குறிப்பாக, மாணவர்களின் கல்வித்தேவைக்கு மிக அவசியமாகின்றது. மாணவர்கள் செய்யும் வீட்டுப்பாடங்கள் எழுதும் கட்டுரைகளை மதிப்பீடு செய்து தவறுகளைச் சுட்டிக்காட்டித் திருத்துகின்றது. சரியான முறையில் எழுதப் படிக்க மாணவர்களை வழிநடத்துகின்றது. போட்டித் தேர்வுகளுக்குத் தங்களைத் தயார் செய்யும் மாணவர்களுக்கு வலையொளியில் (Youtube) உள்ள காணொளிப் பாடங்கள் (Video Lessons) மிகவும் பயனுள்ளதாக அமைகின்றன. தங்களுக்குத் தெரிந்த பயனுள்ளக் கருத்துக்களைப் பதிவேற்றம் செய்யவும் சமூக வலைதளங்கள் உறுதுணையாக உள்ளன. நேரடி வகுப்புகளில் புரிந்து கொள்ள முடியாத கருத்துக்களையும் காணொளி பாடங்கள் மூலம் எளிதில் புரிந்து கொள்ள முடிகின்றது என்று 88.5% மாணவர்கள் தெரிவித்துள்ளனர்.



Covid – 19 என்ற புதிய தொற்றின் (Virus) மூலம் மாணவர்களின் கல்விப் பயணத்திற்கு இடையூறு வராமல் தடுக்க இணையவழி வகுப்புகள் பெரிதும் துணைபுரிகின்றன. இதனால் ஆசிரியர்களும் மாணவர்களும் தங்களது இருப்பிடங்களில் இருந்தே எளிமையாகத் தொடர்பு கொள்ள முடிகின்றது. பல கருத்தரங்க நிகழ்வுகளும் இணையதளத்தின் வழி நிகழ்த்தப்படுகின்றன. நேரில் கலந்துகொள்ள முடியாத சூழல்; வெளிநாடுகளில் வசிப்பவர்கள் நேரில் வருவதற்கு ஏற்படும் சிக்கல் போன்ற தடைகளை இணையதளக் கருத்தரங்கம் முறியடிப்பதை உணரமுடிகின்றது. இணையதளம் மூலம் மாணவர்கள் தங்களுக்குத் தேவையானத் தகவல்களைப் பெறுவதற்கான நேரசுதந்திரம், உலகளாவிய வேலை வாய்ப்பு, சுய கற்றல் திறன் வளர்தல் என்று பல நன்மைகள் கிடைக்கின்றன. இக்கருத்தை கீழ்க்காணும் தரவு உறுதி செய்கின்றது.



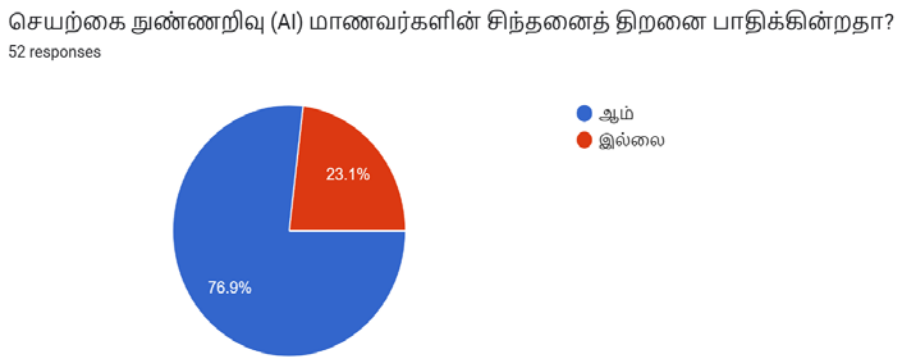
40.4% மாணவர்கள் உலகத்தில் கிடைக்ககூடிய பல்வேறு வாய்ப்புகளை

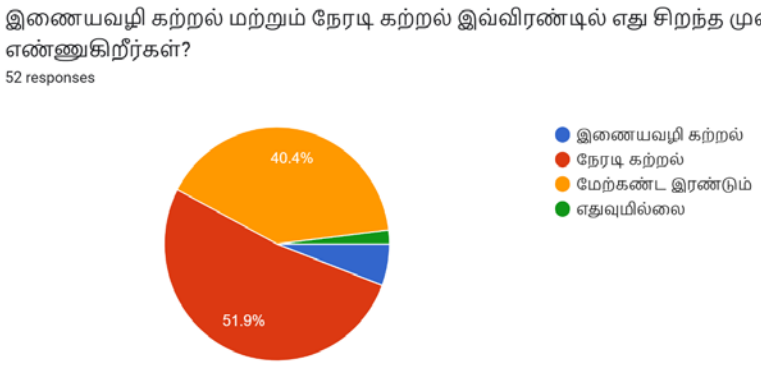
அடைய இணையதள கல்வி வழி செய்கின்றது என்றும் 23.1% மாணவர்கள் தங்களுக்கு ஏற்றார் போல் நேரத்தை பகுத்து செலவிட எதுவாக அமைகின்றது என்றும் 34.6% மாணவர்கள் இணையதள கல்வி மூலம் தங்களது சுய கற்றல் திறன் மேம்படுவதாகவும் குறிப்பிட்டுள்ளனர். இவ்வாறு பலவகையான பாராட்டத்தக்க நன்மைகளைத் தொழில்நுட்பம் செயல்படுத்திக் கொண்டு வருவதை ஆய்வின் வழி அறியமுடிகின்றது.

பாதக விளைவுகள்

பலவகையான நன்மைகளை வழங்கிக் கொண்டிருக்கின்ற தொழில்நுட்பத்தினால் சில தவறுதலான செயல்முறைகளும் இச்சமூகத்தில் நிகழ்கின்றன. மாணவர்கள் கல்விக்காக அதிக நேரம் கைப்பேசி அல்லது கணினி போன்றவற்றை உபயோகப்படுத்தும் பொழுது கண் எரிச்சல், தலைவலி, மனச்சோர்வு போன்ற ஆரோக்கியப் பாதிப்புகள் ஏற்படுகின்றன. இப்போது உள்ள தலைமுறையினர் பல்வேறு நவீன மாற்றங்களுக்கு உட்படுத்தப்பட்டுள்ளனர். படிப்பதற்கு இன்றைய காலகட்டத்தில் தொழில்நுட்பக் கருவிகள் அவசியம் என்று எண்ணி பெற்றோர்கள் தங்களது பிள்ளைகளுக்குக் கைப்பேசி, கணினி போன்றவற்றை வழங்குகின்றனர். ஆனால், சில மாணவர்கள் கல்விக்காக அதனைப் பயன்படுத்தும் நேரத்தைக் குறைத்துக் கொண்டு பொழுதுபோக்குச் சாதனமாக முழுவதும் பயன்படுத்துகின்றனர். பல தவறான காணொளிகளைக் கண்டு தீயப் பழக்க வழக்கங்களுக்குத் தங்களைத் தயார் செய்கின்றனர். உண்ணும் பொழுது, தூங்கும் பொழுது, பயணிக்கும் பொழுது, குடும்பம் மற்றும் உறவினர்களுடன் நேரம் செலவிடும் பொழுது என அனைத்து நேரங்களிலும் கைப்பேசியைப் பார்த்துக் கொண்டிருக்கும் நிலை இன்று பெருகி விட்டது. இதனால் நேரடி உரையாடல்கள் குறைந்து விட்டன. வீட்டிற்குள்ளேயே தங்களைத் தனிமைப்படுத்திக் கொள்கின்றனர். ஆசிரியர் மானவர்களிடத்தும் நேரடி கலந்துரையாடல்கள் குறைகின்றன. தங்களுக்குத் தேவையான அனைத்துத் தகவல்களையும் இணையம் வழங்குவதனால் மாணவர்களின் சுயசிந்தனை ஆற்றலுக்கு இது தடையாக அமைகின்றது. இதனால் உறவு நிலைச் சிக்கலும் உடல், உளச் சிக்கலும், உருவாகி எதிர்கால நிலையும் கேள்விக்குறியாகும் சூழல் அமையும் என்பதை அறியமுடிகின்றது. தொழில்நுட்பம் பல்வேறு தகவல்களை

மாணவர்களுக்கு அளிப்பதாக இருப்பினும் மாணவர்கள் அதனை ஒரு வழிகாட்டியாக மட்டுமே பயன்படுத்தாமல் தங்களுக்குத் தேவையான முழு தகவலையும் தொழில்நுட்பத்தினை பயன்பத்திப் பெற்றுக்கொள்கின்றனர். இதனால் அவர்கள் சிந்திக்கும் திறனை இழக்கின்றனர். கருத்துத் திருட்டு என்ற தீமையும் இங்கு நிகழ்வதற்காண சூழலைத் தொழில்நுட்பம் ஏற்படுத்துகின்றது. பல இடங்களில் மாணவர்கள் தங்களுக்கு கொடுக்கப்படக்கூடிய செயல்பாடுகளை விரைவாக முடிப்பதற்காக இம்மாதிரியான கருத்துத் திருட்டினை செய்கின்றனர். ஆசிரியர்கள் மேற்கொள்ளும் நேரடி வகுப்புகளை 20 நிமிடம் கூட தொடர்ந்து மாணவர்களால் கவனிக்க முடியாத நிலையைத் தொழில்நுட்பம் இன்று உருவாக்கியுள்ளது. AI என்றழைக்கப்படும் செயற்கை நுண்ணறிவு மனிதனால் செய்யப்படும் வேலைகளையும் எளிமையாகச் செய்வதனால் வேலைவாய்ப்புக் குறைகின்றது என்பதை சமூகத்தில் இன்று நிலவும் பணியிழப்புச் சூழல் உறுதிப்படுத்துவதன் வழி காணமுடிகின்றது. 76.9% மாணவர்கள், செயற்கை நுண்ணறிவு மாணவர்களின் சிந்தனைத் திறனைப் பாதிகின்றது என்ற கருத்தினை ஏற்றுக்கொள்கின்றனர்.





எவ்வளவு தான் சமூகம் கல்வித்துறையில் தொழில்நுட்ப முன்னேற்றங்களை அடைந்து மாணவர்களின் சுய கற்றல் திறனை வளர்த்தாலும் பல நேரங்களில் அவர்களுக்குத் தேவையான முழு புரிதலுக்கு ஆசிரியர்களின் வழிகாட்டுதல் தேவைப்படுகின்றது என்பதை மேற்காணும் தரவில் 51.9% மாணவர்கள் நேரடி கற்றலைத் தேர்ந்தெடுத்ததன் வழி அறிமுடிகின்றது.

முடிவுகள் மற்றும் விவாதங்கள்

பள்ளி மற்றும் கல்லூரி மாணவர்களிடமிருந்து பெறப்பட்ட தகவல்களின் அடிப்படையில் தொழில்நுட்பம் மாணவர்களின் கற்றல் திறனை மேம்படுத்துகின்றது என்ற கருத்தை மாணவர்கள் 100% ஒப்புக்கொள்கின்றனர். கல்விக்காகத் தினமும் இணையதளத்தை 90.4% மாணவர்கள் பயன்படுத்துகின்றனர். ஆசிரியர்கள் ஸ்மார்ட் கிளாஸ் போன்ற தொழில்நுட்பத்தைக் கற்பித்தலில் பயன்படுத்துவது மிகவும் பயனுள்ளதாகவும், புரிதலுக்கு வசதியாகவும் உள்ளது என்று 98.1% மாணவர்கள் தங்களது கருத்தைத் தெரிவித்துள்ளனர். கல்வியில் தொழில்நுட்பத்தைப் பயன்படுத்துவதில் சில குறைபாடுகள் இருப்பினும் அதனுடைய பயன்பாட்டைப் புறக்கணிக்க முடியாது என்ற கருத்தையே இக்கட்டுரை முன்வைக்கின்றது. மாணவர்களிடமிருந்து சேகரிக்கப்பட்ட தகவல்களும் இக்கருத்தையே உறுதியளிக்கின்றன.

முடிவுரை

கல்வியில் தொழில்நுட்பத்தின் பயன்பாடு கற்றல் முறையை எளிதாகவும் பயனுள்ளதாகவும் மாற்றியுள்ளது என்பதை இவ்வாய்வின் மூலம் அறியமுடிகின்றது. இது, மாணவர்கள் தகவல்களை விரைவாக பெறுவதற்கும் தங்களது அறிவை வளர்த்துக் கொள்வதற்கும் உதவியாக

அமைகின்றது என்பது இவ்வாய்வு வழி புலனாகின்றது. ஆயினும் தொடர்ந்து கையாளப்படும் தொழில்நுட்பக் கருவிகளால் எதிர்காலச் சந்ததியினரின் ஆரோக்கியம், உடல், மனநலம் ஆகியவை குன்றுகின்ற நிலையையும் காணமுடிகின்றது. எனவே, தொழில்நுட்பத்தைச் சரியான முறையில் பயன்படுத்துவது மிகவும் அவசியம் என்றும் ஆசிரியர்களின் வழிகாட்டுதலுடன் அதனைப் பயன்படுத்தினால் கல்வித் தரம் உயரும் என்ற கருத்தினையும் இந்த ஆய்வு முன்வைக்கின்றது. எனவே, கல்வியில் தொழில்நுட்பம் ஒரு முக்கியமான கருவியாக இருந்து இன்றைய சூழலில் மட்டுமல்லாது எதிர்காலக் கல்வி வளர்ச்சிக்கும் பெரும் பங்காற்றும் என்ற கருத்தையும் எதிர்பார்ப்பையும் உரிய சான்றுகளின் வழி இந்த ஆய்வு உறுதி செய்கின்றது.

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A New Blueprint for China-Malaysia Educational Cooperation under the Belt and Road Initiative

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Abstract

In the global landscape of international Chinese language education, overseas Chinese language education holds significant importance. Malaysian Chinese language education has a long history and a well-established system. In recent years, with the deepening of China-Malaysia relations, Malaysian Chinese language education has ushered in new opportunities. This paper focuses on the new trends of Malaysian Chinese language education over the past decade or so, exploring how it has achieved structural innovation and transformation in education under the interaction of the national government, relevant institutions, and overseas forces. The study sorts out the process of institutional breakthroughs in the legitimacy of Chinese language education, including policy transformation driven by the practical value of Chinese and the paths of legitimacy manifestation; analyzes the functional upgrading and teaching reform during the period of subject transformation of Chinese language education, covering the transformation of non-governmental forces and the innovation of teaching practices in Chinese schools; and elaborates on the new stage of China-Malaysia educational cooperation under the background of the Belt and Road Initiative, involving demand-driven cooperation to promote resource connection and emerging technological empowerment for resource circulation. Finally, it concludes the transformation path of Malaysian Chinese language education within the relevant framework, providing a reference for the high-quality development of global Chinese language education, and looks forward to the future of China-Malaysia Chinese language education cooperation from three aspects: institutional connection, technological tool expansion, and multilingual and multicultural ecological construction.

Keywords: China-Malaysia Educational Cooperation, Institutional Breakthroughs, Malaysian Chinese Language Education, Subject Transformation, Teaching Reform

Introduction

Sustainable Overseas Chinese-language education is an integral component of international Chinese-language education, undertaking the mission of mother tongue education for overseas Chinese and cultural inheritance. Malaysia boasts one of the earliest and most complete overseas Chinese-language education systems, dating back to 1819 with the establishment of Wufu Academy. By 2026, Malaysia has built a modern Chinese-language teaching system covering primary, secondary and higher education; once positioned as "overseas Chinese education", it has gradually integrated into the national education system, evolving into a "cultural buffer zone" that promotes multi-ethnic solidarity while inheriting Chinese culture.

China and Malaysia established diplomatic relations in 1974, a comprehensive strategic partnership in 2013, and announced the construction of a high-level strategic community with a shared future in 2025, identifying educational cooperation as a key priority. Under the BRI, regional connectivity and transnational collaboration have injected new impetus into Malaysian Chinese-language education and laid a foundation for bilateral talent flow.

Malaysian Chinese-language education has long been a research focus. Existing studies mainly focus on its development process, independent school dilemmas and educational practices, mostly from a power game perspective. However, with policy relaxation, rising practical value of Chinese, and the proportion of non-Chinese students in Chinese primary schools exceeding 22% by 2026, the focus of Malaysian Chinese-language education has shifted from survival to quality improvement and innovation.

Against the backdrop of the global technological revolution, there is an urgent need for systematic analysis of its resource integration and reform path. This study focuses on new phenomena over the past decade, updates data to 2026, explores its structural renewal through multi-stakeholder interaction, and provides a reference for deepening international Chinese-language education under the BRI.

Review of Related Literature

International Research

International scholars' research on Malaysian Chinese-language education mainly focuses on the evolution of national language education policies, the ethnic game behind policy adjustments, and the practical effects of educational practice, with a research focus on policy pragmatism and multi-ethnic adaptation. Coluzzi Paolo (2017) conducted a long-term tracking study on Malaysia's language education policy, pointing out that the country's long-term adherence to a single Malay language policy was originally to strengthen national unity and ethnic integration, but with the deepening of globalization and Malaysia's integration into regional economic cooperation, this policy has gradually shown incompatibility—Malaysian enterprises and talents need multilingual capabilities to connect with the international market, and the practical value of Chinese and English has been continuously highlighted. His research also noted that the Malaysian government's policy adjustment of Chinese-language education is not a passive compromise, but a proactive adaptation to national economic and social development needs.

Yasmin Ramlan (2019) adopted an empirical research method, selecting 15 Chinese primary and secondary schools in Kuala Lumpur, Penang and other major cities as research sites, and conducting questionnaires and interviews with 500 non-Chinese parents and 120 Chinese school teachers. The research found that non-Chinese parents choose to send their children to Chinese schools, not out of recognition of Chinese culture, but mainly because Chinese schools have a more rigorous disciplinary environment, advanced teaching philosophy, and excellent further education results—graduates of Chinese schools have obvious advantages in entering local public universities and international universities. This finding also confirms that Malaysian Chinese-language education has gradually broken away from the label of "ethnic education" and become a public educational resource recognized by all ethnic groups.

In terms of specific educational practice, international studies have focused on the application of international advanced teaching models in Malaysian Chinese schools. Scholars such as Tan Bee Tin (2021) explored the application effect of the CLIL (Content and Language Integrated Learning) teaching model in Malaysian Chinese independent secondary schools, taking the science and business courses of 3 key Chinese independent secondary schools as research cases. The research found that the CLIL model, which integrates Chinese language learning with professional knowledge teaching, not only improves students' Chinese application ability, but also enhances their professional literacy, and is highly recognized by students, parents and the Malaysian Ministry of Education. In addition, some international scholars have studied the impact of digital technology on Malaysian Chinese-language education, but most of the research stays at the theoretical discussion level, lacking empirical data support and in-depth analysis of practical application constraints, and there is no relevant research updated to 2026.

Domestic Research

Chinese scholars' research on Malaysian Chinese-language education has formed a multi-dimensional and multi-angle research system, covering the historical evolution of Chinese-language education, policy dilemmas, school development, and China-Malaysia educational cooperation, with a clear research context from "survival dilemma" to "quality development". Li Xirui and Zhang Xiaowei (2023) explored the development dilemma and path of Chinese-language education in Malaysia's national education system from the dual perspectives of national identity and ethnic identity. Their research pointed out that Malaysian Chinese-language education has long been in a "marginalized" position in the national education system, and the core contradiction lies in the conflict between ethnic cultural inheritance and national unity. They proposed that the solution to this contradiction lies in promoting the localization adaptation of Chinese-language education while maintaining its cultural characteristics, so as to realize the organic integration of Chinese-language education and the national education system.

Lin Minping (2019) took Malaysian independent Chinese secondary schools as the core research object, focusing on their survival mechanism and development challenges under the "institutional outside" status. His research sorted out the historical evolution of independent Chinese secondary schools since the founding of Malaysia, pointing out that these schools have maintained their survival and development through social donations, community support and self-innovation, but they still face many challenges: insufficient financial resources, difficulty in recognizing academic certificates, and shortage of professional teachers. His research also put forward targeted suggestions, such as strengthening cooperation with Chinese universities to improve the professional quality of teachers and promoting the recognition of UEC certificates at the national level.

With the deepening of the Belt and Road Initiative, domestic research has gradually shifted to the field of China-Malaysia educational cooperation. Qian Wei (2020) pointed out in his research that the transformation and upgrading of Malaysian Chinese-language education cannot rely solely on internal forces, and transnational educational cooperation and technological empowerment are important external driving forces. He proposed that China should strengthen cooperation with Malaysia in teacher training, curriculum development and digital education, and help Malaysian Chinese-language education improve its quality and level. Dong Wenlong and Samah Mufra (2024) conducted a joint research on the coordinated development of Chinese-language education and vocational education between China and Malaysia, taking the Luban Workshop and Confucius

Institute as research cases. Their research found that the "Chinese + Vocational Skills" education model can not only improve Malaysian students' Chinese language ability and professional skills but also promote the connection between Malaysian vocational education and international industrial trends, which is an important path for China-Malaysia educational cooperation to achieve win-win results. Lei Li and Yang Shuang (2023) used the ecosystem theory to analyze the risks faced by Malaysian Chinese-language education in the new situation, such as policy risks, resource risks and technological risks, and put forward corresponding countermeasures, providing a theoretical reference for the stable development of Malaysian Chinese-language education.

Research Gaps

Although existing domestic and international studies have conducted in-depth discussions on Malaysian Chinese-language education and China-Malaysia educational cooperation, and accumulated rich research results, there are still obvious research gaps, which also constitute the research space and innovation points of this study:

First, most existing studies focus on the survival dilemma of Malaysian Chinese-language education and the historical evolution of policies, and the research on its structural transformation from "survival-oriented" to "quality-development-oriented" is not systematic enough. Especially after 2020, with the relaxation of Malaysian national policies, the continuous increase of non-Chinese students, and the deepening of China-Malaysia educational cooperation, Malaysian Chinese-language education has undergone profound changes in policy legitimacy, subject functions and educational practice, but existing studies have not conducted in-depth analysis of these new changes, and the research content is relatively outdated.

Second, the research on China-Malaysia educational cooperation mostly stays at the level of experience summary and theoretical discussion and lacks in-depth analysis of the innovative mechanism and practical effect of cooperation. For example, the "order-based" teacher cooperation model and "Chinese + Vocational Skills" education model, which have achieved remarkable results in recent years, have not been studied in detail—existing studies only mention the existence of these models, but do not analyze their operation mechanism, implementation effect and existing constraints, and cannot provide effective reference for the deepening of China-Malaysia educational cooperation.

Third, the research on technological empowerment in Malaysian Chinese-language education is relatively fragmented. Existing studies only briefly mention the application of digital technology in Chinese-language education but lack overall research on the application of artificial intelligence, new media and other technologies in Chinese schools, as well as the existing constraints and solutions. In addition, most existing studies use data before 2023, and there is a lack of research updated with the latest data in 2026, such as the latest situation of non-Chinese student proportions, UEC recognition, and China-Malaysia digital education cooperation, which affects the timeliness and pertinence of the research.

This study will focus on filling the above research gaps, take the new changes and new phenomena of Malaysian Chinese-language education since 2013 as the research focus, update the relevant data to 2026, and conduct in-depth analysis of its structural transformation path and China-Malaysia educational cooperation model, so as to enrich the research results of Malaysian Chinese-language education and provide a valuable

reference for the deepening of China-Malaysia educational cooperation and the high-quality development of global Chinese-language education under the BRI.

International Research

International scholars mainly focus on language policy evolution and ethnic dynamics. Coluzzi Paolo (2017) noted that Malaysia's single Malay language policy is incompatible with globalization, and Chinese's practical value has increased. Yasmin Ramlan (2019) found that non-Chinese parents choose Chinese schools for their disciplinary environment and teaching quality. International studies also affirm the effectiveness of CLIL models in Malaysian Chinese schools.

Domestic Research

Chinese scholars have formed a multi-dimensional research system. Li Xirui and Zhang Xiaowei (2023) explored its dilemmas from national and ethnic identity perspectives. Lin Minping (2019) analyzed independent Chinese secondary schools' survival mechanisms. Under the BRI, Qian Wei (2020) emphasized the importance of transnational cooperation and technological empowerment, while Dong Wenlong and Samah Mufra (2024) focused on "Chinese + Vocational Skills" integration.

Research Gaps

Three gaps exist: 1) Insufficient research on its transformation from "survival" to "development", especially post-2020 policy and subject changes; 2) Lack of in-depth analysis of innovative cooperation mechanisms such as "order-based" teacher cooperation; 3) Fragmented research on technological empowerment, with no 2026 data updates. This study fills these gaps.

Objectives

Research Objectives

1) Sort out the institutional breakthrough of Chinese-language education legitimacy (2013-2026) and clarify policy evolution;
2) Analyze the functional upgrading of educational subjects and teaching reform practices;
3) Explore new stages and models of China-Malaysia educational cooperation under the BRI;
4) Summarize transformation paths and put forward targeted suggestions.

Research Questions

1) What are the main manifestations of legitimacy breakthroughs, and how has national policy adjusted by 2026?
2) How have subjects transformed from "fighters" to "builders", and what teaching reforms have been carried out?
3) What innovative cooperation models have been formed, and how have they optimized resources?
4) What constraints exist in 2026, and how to deepen cooperation for high-quality development?

Methodology

This study adopts qualitative methods based on document analysis, case analysis, and 2026 data updates:

1) **Document Analysis**: Sort out Malaysian education policies (2013-2025 Blueprint, 2023 Digital Education Policy), China-Malaysia cooperation documents, and reports from Dong Jiao Zong and Malaysia's Ministry of Education.
2) **Case Analysis**: Select typical cases (CLIL in Kuala Lumpur Chinese Independent High School, "order-based" teacher cooperation, engineering Confucius Institute, AI courses in Batu Pahat Hua Ren High School).
3) **Data Updating**: Integrate 2026 data on non-Chinese student proportions, financial allocations, and UEC recognition to ensure timeliness.

This study constructs a framework integrating institutional and actor perspectives, with three core dimensions: national education system evolution, educational subject transformation, and China-Malaysia cooperation deepening. The core logic is: policy relaxation provides institutional foundation; subject transformation is internal driving force; BRI cooperation is external driving force, forming a "government guidance, social participation, technological empowerment" mechanism.

Analysis

Institutional Breakthrough of Legitimacy (2013-2026)

Driven by Chinese's practical value under globalization and the BRI, Malaysia has adjusted education policies, realizing legitimacy breakthroughs with "pragmatism" and "adaptability" characteristics.

Policy Transformation Driven by Chinese's Practical Value

Malaysia's education policy was long dominated by Malay elites, emphasizing a unified Malay-medium system. The 2002 PPSMI policy (teaching math/science in English) reflected policy reflection. The 2013-2025 Education Blueprint, once worrying to the Chinese community, was not implemented as an assimilation policy. By 2026, Chinese has become important for Malaysia's cooperation with China and ASEAN under the BRI. Non-Chinese student proportions in Chinese schools have risen continuously (Table 1).

Table 1: Changes in the Proportion of Non-Chinese Students in Malaysian Chinese Schools (2016-2026)

Year	Proportion of Non-Chinese Students in Chinese Primary Schools	Proportion of Non-Chinese Students in Independent Chinese Secondary Schools	Additional Notes
2016	7%	Not available	Data from Malaysia's Ministry of Education

2021	19.2%	Over 10%	First significant increase in secondary schools
2026	Over 22%	15%	65/83 Chinese primary schools in Sabah have >70% non-Chinese students

Three Manifestations of Legitimacy Improvement (2026 Update)

Legitimacy improvement is reflected in public resource allocation, curriculum integration, and examination recognition (Table 2):

1) **Financial Support:** Annual grants to 1,302 Chinese primary schools increased from 98.01 million ringgit (2023) to 120 million ringgit (2026), covering infrastructure and teacher training.
2) **Curriculum Integration:** Chinese literature courses in national middle schools increased from 64 class hours/year (2019) to 80 class hours/year (2026), fully implemented nationwide.
3) **UEC Recognition:** UEC is now recognized by 5 states (Sabah, Sarawak, Johor, Penang, Selangor), allowing graduates to apply for local civil service and public universities.

Table 2: Key Indicators of Malaysian Chinese-Language Education Legitimacy Improvement (2026 Update)

Legitimacy Improvement Aspect	2019-2023 Status	2026 Updated Status	Policy Significance
Financial Allocation for Chinese Primary Schools	98.01 million ringgit (2023)	120 million ringgit per year	Stable position in public education system
Chinese Literature Course in National Middle Schools	64 class hours/year, elective	80 class hours/year, fully implemented	Expanded national curriculum coverage
UEC Recognition	Recognized by Sabah (2019), Sarawak (2024)	Recognized by 5 states	Foundation for national-level recognition

Functional Upgrading of Subjects and Teaching Reform
Educational subjects have transformed from "fighters" to "builders", focusing on quality improvement, with functional upgrades and teaching reforms:

Civil Organizations: From Rights Protection to High-Quality Development
Dong Jiao Zong has shifted from rights protection to promoting high-quality development. By 2026, it has held 8 sessions of *New Direction of Chinese Education* activities, and its 2020 "Cloud Classroom" has evolved into a comprehensive platform covering all Chinese schools with 10,000+ registered teachers. The "MSEF Teacher Appreciation Program" covers all independent Chinese secondary schools, supporting 5,000+ teachers.

Chinese Communities: From Single Donation to Multi-Dimensional Participation
Chinese communities now participate in volunteer services, cultural inheritance, and school-community cooperation. Volunteers provide tutoring, cultural activities integrate into campus life, and practice bases promote social integration.

Teaching Reform in Chinese Schools
To adapt to multi-ethnic student sources, schools have implemented: 1) Balanced trilingual teaching (Chinese, Malay, English); 2) CLIL model promotion in science, business, and IT courses; 3) Inclusive campus culture (Malay cultural activities, religious classrooms).

China-Malaysia Educational Cooperation (2024-2026)
Under the 2024 BRI Cooperation Plan and 2025 strategic community initiative, cooperation has transformed from aid-based to demand-oriented, with innovative models and technological empowerment.

Demand-Oriented Innovative Models
1) "**Order-based" Teacher Cooperation**: Alleviates teacher shortages. By 2026, over 200 Chinese schools have sister-school relationships with Chinese counterparts; Nanning Minzhu Road Primary School has trained 300+ local teachers and covered 15,000+ students in Sabah.
2) "**Chinese + Vocational Skills**": With Confucius Institute as pilot (2,000+ technical talents trained) and 12 Luban Workshops as core (5,000+ compound talents trained), covering infrastructure, e-commerce, and intelligent manufacturing (Table 3).

Table 3: Key Achievements of China-Malaysia "Chinese + Vocational Skills" Education Cooperation (2026)

Cooperation Model	Core Institution/Project	Quantity/Achievements (2026)	Covered Fields
Confucius Institute (Pilot)	Engineering and Technology Confucius	2,000+ technical talents trained	Engineering, e-commerce, intelligent manufacturing

	Institute (UMS & CSUST)		
Luban Workshop (Core)	Chinese-Malaysian vocational college cooperation	12 workshops, 5,000+ compound talents trained	Infrastructure, e-commerce, tourism

Technological Empowerment and Constraints

Under Malaysia's Digital Education Policy, Chinese tech enterprises have promoted AI and new media application. By 2026, 30+ independent Chinese secondary schools have AI courses and smart classrooms; Batu Pahat Hua Ren High School has 5 AI classrooms and 1,000+ AI-literate students. However, infrastructure imbalance persists (Table 4).

Table 4: Digitalization and AI Application Progress in Malaysian Chinese Independent Secondary Schools (2023-2026)

Indicator	2023 Status	2026 Status	Key Driver
Schools without Administrative Management Systems	9/59 surveyed (7 in East Malaysia)	4/59 surveyed	China-Malaysia digital cooperation
Schools with AI Courses & Smart Classrooms	1 pilot school	30+ independent Chinese secondary schools	Cooperation with Chinese ed-tech enterprises
5G Network Coverage of Chinese Schools	Major cities only	All major cities + most underdeveloped areas	U Mobile + Huawei/ZTE cooperation (2025)

New media (TikTok, Xiaohongshu) and online platforms (Tencent Meeting) have promoted informal cooperation and teacher training (5,000+ Malaysian teachers trained by 2026). However, rural-urban "digital divide", insufficient digital teachers, and uneven state investment remain constraints.

Findings and Discussion

Based on 2026-updated data and analysis, core findings are:

Finding 1: Legitimacy Institutional Breakthrough

Malaysia's education policy has become pragmatic; Chinese-language education legitimacy is enhanced through increased financial support (120 million ringgit/year), expanded curriculum coverage (80 class hours/year), and UEC recognition by 5 states. Non-Chinese student proportions exceed 22% (primary) and 15% (secondary), confirming its role as a shared resource.

Finding 2: Subject Transformation to Collaborative Development
Dong Jiao Zong, communities, and enterprises have upgraded functions; schools have implemented trilingual teaching, CLIL models, and inclusive culture. A multi-stakeholder collaborative pattern has formed as the internal driving force.

Finding 3: Innovative China-Malaysia Cooperation
Cooperation has become demand-oriented, with "order-based" teacher cooperation (200+ sister schools) and "Chinese + Vocational Skills" (12 Luban Workshops, 5,000+ talents trained), marking institutionalized and systematic cooperation.

Finding 4: Technological Empowerment with Infrastructure Constraints
AI and new media have empowered development (30+ AI-equipped schools), but infrastructure imbalance, digital teacher shortage, and uneven investment form bottlenecks affecting fairness and high-quality development.

Theoretical Implications

1) **Enrich the research on the development of overseas Chinese-language education**: This study systematically analyzes the structural transformation path of Malaysian Chinese-language education from "survival" to "development", and updates the latest data to 2026, making up for the lack of systematic research on the new changes of Malaysian Chinese-language education in existing studies, and enriching the theoretical research on the development of overseas Chinese-language education under the background of the BRI.
2) **Perfect the analytical framework of overseas Chinese-language education development:** This study constructs an analytical framework integrating institutional and actor perspectives, and clarifies the interaction mechanism between national education system evolution, educational subject role transformation and transnational educational cooperation, which provides a new theoretical framework for the research on the development of overseas Chinese-language education in other countries.
3) **Expand the research on transnational educational cooperation under the BRI:** This study in-depth analyzes the innovative models and implementation effects of China-Malaysia educational cooperation such as "order-based" teacher cooperation and "Chinese + Vocational Skills" education, and reveals the transformation law of transnational educational cooperation from aid-based to collaborative, which expands the research on transnational educational cooperation under the BRI.

Practical Implications

Implications for the Deepening of China-Malaysia Educational Cooperation
Based on the research findings and the latest development of Malaysian Chinese-language education in 2026, this study puts forward three paths for further deepening China-Malaysia educational cooperation:

1) **Strengthen institutional docking and improve the certification system:** Promote the inclusion of Chinese language proficiency in the credit recognition and vocational skill certification system of China-Malaysia cooperative education, and jointly formulate Chinese language teaching standards and vocational skill certification standards adapted to the needs of the BRI. At the same time, China and Malaysia jointly promote the central government of Malaysia to fully recognize the unified

examination certificate of independent Chinese secondary schools, further improving the legitimacy of Malaysian Chinese-language education at the national level.

2) **Optimize the resource supply model and strengthen targeted cooperation:** Continue to promote the "order-based" cooperation model, and according to the different needs of Chinese schools in different regions of Malaysia (such as the shortage of teachers in East Malaysia and the demand for digital education in West Malaysia), carry out targeted teacher training, curriculum development and equipment support. Strengthen the cooperation between Chinese higher vocational colleges and Malaysian local institutions, and expand the coverage of Luban Workshop to more professional fields.
3) **Solve infrastructure constraints and promote the balanced development of digital education:** China's science and technology enterprises and telecom companies continue to cooperate with Malaysia to accelerate the construction of 5G networks and digital teaching equipment in underdeveloped areas such as East Malaysia, and provide technical training and maintenance support for local schools. China and Malaysia jointly set up a digital education development fund to support the digital transformation of Chinese schools in underdeveloped areas, promoting the balanced development of Malaysian Chinese-language education.

Implications for the High-Quality Development of Global Chinese-Language Education

Malaysian Chinese-language education has formed a localized development model of "rooted in the local, connected to the region and facing the world" under the BRI, which provides important practical implications for the high-quality development of global Chinese-language education:

1) **Adhere to local adaptation and integrate into the national education system of the host country**: Overseas Chinese-language education should take into account the national education policy and ethnic cultural characteristics of the host country, actively adapt to the local social and economic development needs, and realize the integration into the national education system of the host country while inheriting Chinese culture, so as to obtain sustainable development power.
2) **Promote multi-subject collaboration and mobilize social forces to participate:** Overseas Chinese-language education should give full play to the role of civil organizations, ethnic communities and enterprises, form a multi-subject collaborative development pattern, and solve the problems of resource shortage and institutional constraints through social participation, so as to realize the transformation from "ethnic internal cause" to "social common cause".
3) **Emphasize demand-oriented transnational cooperation and realize precise resource docking:** International Chinese-language education cooperation should abandon the traditional aid-based model, adhere to the principle of "on-demand supply", carry out targeted cooperation according to the actual needs of the host country, and realize the precise docking of educational resources, so as to improve the effectiveness of cooperation.
4) **Strengthen technological empowerment and promote the digital transformation of Chinese-language education**: With the development of artificial intelligence and digital education, overseas Chinese-language education should actively embrace technological innovation, use new media, artificial intelligence and other technologies to upgrade teaching models, expand

educational channels, and realize the digital transformation of Chinese-language education, so as to adapt to the development needs of the digital age.

Limitations and Future Research Directions

This study has certain limitations: first, it mainly adopts qualitative research methods such as document analysis and case analysis, and the empirical research on the effect of Chinese-language education teaching reform and China-Malaysia educational cooperation is insufficient; second, the research on the long-term impact of the increase of non-Chinese students on Malaysian Chinese-language education is not in-depth enough.

Future research can focus on the following directions: first, adopt mixed research methods combining qualitative and quantitative, and conduct empirical research on the teaching effect of CLIL model and the employment effect of "Chinese + Vocational Skills" education through questionnaire survey and interview; second, in-depth analyze the long-term impact of the increase of non-Chinese students on the cultural inheritance and teaching design of Malaysian Chinese-language education, and explore the balance between multi-cultural integration and Chinese cultural inheritance; third, expand the research scope to other ASEAN countries, and carry out a comparative study on the development model of overseas Chinese-language education, so as to provide more comprehensive reference for the high-quality development of global Chinese-language education under the BRI.

Conclusion

This study takes the new landscape of Malaysian Chinese-language education under the BRI as the research object, updates the relevant data and policy developments to 2026, and conducts an in-depth analysis from the three dimensions of national education system evolution, educational subject role transformation and China-Malaysia educational cooperation deepening based on the analytical framework integrating institutional and actor perspectives. The study concludes that Malaysian Chinese-language education has experienced a profound structural transformation from 2013 to 2026: in terms of policy, it has realized the institutional breakthrough of legitimacy, and the national education policy has shown the characteristics of pragmatism and adaptability; in terms of subjects, the main educational subjects have completed the role transformation from "fighters" to "builders", forming a multi-subject collaborative development pattern; in terms of international cooperation, China-Malaysia educational cooperation has entered a new stage of institutionalized and systematic cooperation, with the formation of demand-oriented innovative models such as "order-based" teacher cooperation and "Chinese + Vocational Skills" education; in terms of development mechanism, it has formed a coordinated mechanism of "government guidance, social participation and technological empowerment", realizing the transformation from "survival" to "development".

The development of Malaysian Chinese-language education is the result of the interaction of multiple factors: the deepening of globalization and the BRI has highlighted the practical value of the Chinese language, which is the external background; the adjustment of Malaysia's national education policy and the recognition of Chinese-language education are the institutional foundation; the active transformation and innovation of educational subjects are the internal driving force; and the deepening of China-Malaysia educational cooperation and technological empowerment are the important impetus. Up to 2026, Malaysian Chinese-language education has not only realized its own quality

improvement and functional reorientation, evolving from an ethnic education to a vital part of the national education system, but also become a bridge for cultural communication and talent flow between China and Malaysia, and an important link for Malaysia to participate in the BRI construction.

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Online Communicative Language Teaching: A Case Study of Zoom-Based ESL Instruction in Myanmar

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Abstract

This qualitative case study examines the enactment of Communicative Language Teaching (CLT) in an online English as a Second Language (ESL) lesson for adolescent learners in Myanmar. Primary data were collected in 2024 through non-participant observation of a one-hour Zoom-based session within a volunteer-led English program operating amid ongoing political and educational disruption. The population comprised Myanmar adolescents engaged in remote English learning; using purposive sampling, one session involving two learners was selected for detailed analysis. Data collection relied on structured observational field notes documenting interactional patterns, teacher scaffolding strategies, affective behaviours, and technological interruptions. Secondary data were derived from scholarly literature on CLT, Second Language Acquisition (SLA), online pedagogy, and education in fragile contexts. Primary data were analyzed using inductive thematic analysis to identify recurring patterns in communicative engagement, negotiation of meaning, and contextual constraints. Findings indicate that open-ended questioning, scaffolded interaction, and meaning-focused tasks facilitated learner participation despite unstable connectivity and anxiety-related camera-off behaviour. The study underscores the necessity of adaptive pedagogical strategies and low-bandwidth multimodal resources to sustain communicative competence development in crisis-affected online environments.

Keywords: Communicative Language Teaching; Digital Pedagogy; Fragile Contexts; Learner Engagement; Myanmar; Online ESL

Introduction

English language proficiency has become increasingly important for academic advancement and global communication, especially in regions where educational access is unstable. The rise of online learning has created new opportunities for English instruction, yet it also introduces challenges that affect the quality of interaction between teachers and learners (Sim & Ismail, 2023; Lo, 2023). In Myanmar, political instability and limited access to formal schooling have pushed many adolescents to rely on volunteer-led online English programs as their primary source of language exposure (Hibbs, 2024; Joshi, 2024). Communicative Language Teaching (CLT), which emphasizes meaningful interaction and learner participation, remains a widely accepted approach for fostering communicative competence. However, the effectiveness of CLT in online environments—particularly in low-resource and fragile contexts—remains underexplored, with technological constraints, learner anxiety, and reduced nonverbal cues significantly shaping the learning process (Kemaloglu-Er & Şahin, 2022; Nguyen et

al., 2022). This study investigates how CLT principles are enacted during a Zoom-based ESL lesson for Myanmar learners and examines the interactional, affective, and technological factors influencing communication in this setting.

The shift toward online learning, accelerated by the COVID-19 pandemic, has transformed how English is taught globally, particularly in contexts with political instability such as Myanmar (Lo, 2023; Hibbs, 2024). Many Myanmar learners now depend on volunteer-run virtual classrooms to access English lessons when formal schooling is disrupted. Communicative Language Teaching (CLT), which emphasizes meaningful interaction and learner engagement, has increasingly been applied in online ESL settings, though challenges such as weak internet connectivity and reduced nonverbal cues persist (Sim & Ismail, 2023; Nguyen et al., 2022). This study examines how CLT principles emerge during a Zoom-based ESL session, offering insight into communicative learning within fragile educational environments.

Problem Statement

Although online platforms provide increased access to English learning opportunities for Myanmar youth, the effectiveness of implementing CLT in such environments remains uncertain. Technological limitations, heightened anxiety, and reduced learner visibility disrupt communicative interaction—an essential component of CLT (Kemaloglu-Er & Şahin, 2022; Hibbs, 2024). Existing research rarely focuses on how CLT functions within politically unstable and low-resource settings, leaving a gap in understanding how meaningful communication can be sustained in online ESL contexts. This study addresses this gap by exploring the interactional patterns and challenges observed in a real-time Zoom lesson.

Significance of the Study

This study holds theoretical, pedagogical, and contextual significance. From a theoretical perspective, it contributes to the expanding body of research examining how Communicative Language Teaching (CLT) and Second Language Acquisition (SLA) theories function within digitally mediated environments. While CLT has been widely explored in traditional classroom settings, fewer studies investigate its enactment in low-resource and crisis-affected online contexts (Sim & Ismail, 2023; Kemaloglu-Er & Şahin, 2022). By analyzing real-time communicative interaction in a Zoom-based lesson, this study provides empirical insight into how interactionist and sociocultural principles—such as negotiation of meaning and scaffolding—manifest under technological and affective constraints (Nguyen et al., 2022; Aimin, 2013).

Pedagogically, the study offers practical implications for educators, particularly volunteer teachers supporting learners in unstable educational systems. Research indicates that online ESL instruction presents challenges related to engagement, technological disruption, and reduced nonverbal feedback (Lo, 2023; Kemaloglu-Er & Şahin, 2022). By identifying adaptable strategies, small-group dynamics, and low-bandwidth scaffolding techniques, this study provides context-sensitive recommendations that align with current digital pedagogy research (Sim & Ismail, 2023; Hazar, 2020).

Contextually, this research contributes to limited scholarship on online English instruction in Myanmar's post-2021 educational landscape, where community-led and volunteer-based initiatives have become increasingly significant (Joshi, 2024; Hibbs, 2024). By documenting both the constraints and communicative possibilities within a

fragile setting, the study informs future program design and supports more equitable access to meaningful language learning opportunities.

Review of Related Literature

Communicative Language Teaching and SLA Foundations

Communicative Language Teaching is grounded in the premise that language is best learned through the purposeful exchange of meaning. Rather than emphasizing grammatical accuracy in isolation, CLT centers on the use of language to accomplish communicative goals. Nunan (1991) argues that effective communicative tasks require learners to interpret messages, negotiate misunderstandings, and respond spontaneously—all of which mirror authentic language use outside the classroom.

The theoretical foundations of CLT can be traced to major Second Language Acquisition (SLA) frameworks. Krashen's Input Hypothesis posits that learners progress when they are exposed to comprehensible input just beyond their current competence—input that stimulates cognitive processing without overwhelming learners (Gong, 2023). Long's Interaction Hypothesis builds on this concept by asserting that input becomes meaningful when learners actively participate in negotiation of meaning. Through dialogue, learners may request clarification, repeat problematic phrases, or modify their speech in response to their interlocutor. These interactional moves support noticing, a key process in SLA that helps learners attend to linguistic forms.

Sociocultural theory offers yet another lens for understanding CLT. Rooted in Vygotskian thought, it emphasizes that learning occurs through mediated social interaction, with more experienced speakers providing scaffolding to help learners achieve tasks they cannot yet accomplish independently (Aimin, 2013). Scaffolding might include modeling, reformulating learner errors, or prompting deeper elaboration. In online contexts, such scaffolding may rely on multimodal cues, chat tools, or digital resources.

The integration of these theories underscores the centrality of interaction in language acquisition. CLT operationalizes these principles through communicative tasks, real-world topics, and learner-centered discussions—making it a strong methodological match for synchronous online instruction when technological conditions allow.

Online ESL Teaching and Digital Tools

The rise of digital learning has generated significant interest in how technology can be used to support language learning. Research consistently shows that teachers adopt digital tools when they perceive them to be useful, efficient, and manageable (Sim & Ismail, 2023). Digital platforms—Zoom, Google Classroom, messaging apps—enable synchronous and asynchronous communication, creating multiple channels for interaction.

However, online teaching also presents well-documented challenges. For many teachers, the abrupt transition to online classrooms during the pandemic intensified workload and stress. Lo's (2023) study of Hong Kong ESL teachers reveals substantial frustration related to reduced student engagement, lack of nonverbal feedback, difficulty monitoring breakout rooms, and managing technical issues. These challenges hinder teachers' ability to sustain communicative interaction—an essential component of CLT.

In fragile contexts, the challenges are magnified. Teachers may have limited access to devices or stable internet, and students may struggle with inconsistent connectivity, background noise, or limited digital literacy (Kemaloglu-Er & Sahin, 2022). These factors contribute to inequitable learning experiences and undermine exposure to sustained communicative input.

Digital Tools, Motivation, and Multimodal Learning

Several Digital tools can meaningfully enhance communicative learning by increasing learner motivation and providing varied linguistic input. Hazar (2020) demonstrates that digital games improve vocabulary retention and promote motivation by engaging learners in interactive, goal-oriented activities. Similarly, Nguyen et al. (2022) show that using memes in ESL classrooms supports digital literacy while reducing anxiety and increasing classroom participation. These tools leverage humor, visual cues, and social media conventions to make learning more relatable. Digital multimodality is especially important in online CLT settings because it compensates for the limitations of screen-based environments. Images, videos, emojis, and memes can serve as prompts for discussion, negotiation, and creative expression. When bandwidth is low, text-based chat or images can still support communicative participation.

Online Learning in Fragile or Low-Resource Contexts

Educational research in developing contexts underscores systemic challenges that affect digital learning. Poor infrastructure, socioeconomic inequalities, insufficient teacher training, and limited technical support hinder effective online instruction (Kemaloglu-Er & Sahin, 2022). In Myanmar, these obstacles are exacerbated by political instability, safety concerns, and restricted access to reliable electricity and internet. Despite these limitations, many learners remain highly motivated to participate in online English instruction, recognizing its value for future opportunities.

- Research Objective 1: To explore how CLT principles are demonstrated during an online ESL lesson delivered to adolescent learners in Myanmar.
- Research Objective 2: To identify the technological, affective, and pedagogical factors that influence communicative interaction in an online classroom setting.
- Research Objective 3: To examine how learners engage, respond, and negotiate meaning during Zoom-based CLT activities.

Research Questions

- Research Question 1: How are CLT principles enacted during a Zoom-based ESL lesson for Myanmar adolescents?
- Research Question 2: What challenges—technological, affective, or pedagogical—affect communicative interaction in this online learning environment?
- Research Question 3: How do learners engage and negotiate meaning during CLT-oriented online activities?

Methodology

Research Design

This This study employed a qualitative case study design to examine the enactment of Communicative Language Teaching (CLT) within a real-time online ESL instructional setting. Qualitative case studies are particularly suited to investigating complex, context-

dependent educational phenomena where researcher control is limited (Yin, 2014). The primary data were collected in 2024 through non-participant observation of a one-hour Zoom-based ESL session conducted within a volunteer-led “English Corner” program serving adolescents in Myanmar.The population comprised Myanmar adolescents participating in community-based online English instruction during ongoing political and educational instability. Using purposive sampling, one instructional session was selected for in-depth examination because it reflected typical program structure and communicative teaching practices. The sample consisted of two adolescent learners and one volunteer instructor.

The primary data source was naturalistic classroom interaction observed synchronously via Zoom. Data collection tools included structured observational field notes documenting interactional moves (e.g., clarification requests, negotiation of meaning), teacher scaffolding practices, affective indicators, and technological disruptions. Secondary data were derived from scholarly literature on CLT, Second Language Acquisition (SLA), online ESL pedagogy, and education in fragile contexts (Nguyen et al., 2022; Sim & Ismail, 2023; Kemaloglu-Er & Şahin, 2022). Primary data were analyzed using inductive thematic analysis following Braun and Clarke’s (2006) framework to identify patterns related to communicative engagement, technological constraints, and affective influences.

Participants and Setting

The observed session took place in a volunteer-led online “English Corner” program serving adolescents in Myanmar. The two learners participating represent typical students within Myanmar’s post-2021 educational climate—youth who have experienced prolonged school closures, political uncertainty, and uneven access to technology. As documented in international crisis education research (Hibbs, 2024; Ramzan et al., 2023), learners in such contexts often rely heavily on online learning opportunities to receive any form of consistent instruction. The volunteer instructor, an experienced English speaker trained in communicative teaching strategies, provided a stable and supportive presence in the online environment. The session was conducted on Zoom, a platform widely used for synchronous language instruction but prone to difficulties in low-bandwidth contexts such as Myanmar.

Data Collection

Data were gathered through a one-hour non-participant observation of the Zoom session. Non-participant observation is frequently used in classroom-based SLA research because it allows the researcher to document authentic learner behavior without influencing the instructional interaction (Gass & Selinker, 2008). The field notes recorded:

- interactional moves such as clarification requests, negotiation, and self-corrections
- teacher scaffolding practices, including reformulation, modeling, and probing questions
- affective indicators (e.g., hesitations, pauses, camera-off behavior)
- technological disruptions and their effect on communication flow

This documentation approach mirrors qualitative data collection methods used in many case studies which use naturalistic observation to analyze communicative processes.

Analysis

The data were analyzed using inductive thematic analysis, drawing on the guidelines of Braun and Clarke (2006). After multiple readings, field notes were coded for patterns related to communicative engagement, affective behavior, technological barriers, and classroom interaction. Codes were consolidated into higher-order themes that aligned with the study's research questions and relevant SLA theories. This analytical strategy is consistent with other studies involving online communicative interaction, including Nguyen et al. (2022) and Sim & Ismail (2023), both of which used thematic analysis to examine teachers' and learners' perceptions of digital tools. Through this approach, the analysis highlighted not only what occurred in the session but also how these events connect to broader pedagogical and theoretical implications.

Active Communicative Engagement

The observed session demonstrated consistently active learner engagement, with both students responding to questions willingly and expanding on their ideas when prompted. They frequently drew upon personal experiences, which helped anchor communication in authentic contexts—an essential characteristic of CLT. Learners also exhibited behaviors associated with Interactionist SLA, such as requesting clarification, rephrasing their statements, and modifying their output in response to teacher feedback. These interactional moves reflect negotiation of meaning processes central to language development (Gass & Selinker, 2008). Such communicative exchanges align with the principles of CLT, which emphasize purposeful interaction and meaning-focused language use (Nunan, 1991). Overall, the high level of engagement suggests that even in fragile contexts, motivated learners can participate meaningfully in online communicative tasks when supportive conditions are present.

Advantages of the Small-Group Format

The intimate two-student structure created an environment highly conducive to communicative language development. With fewer participants, the teacher was able to allocate more speaking time to each learner and maintain careful control of classroom dialogue. This structure minimized the common online challenge of students withdrawing from interaction in larger groups, a difficulty frequently reported in digital ESL settings (Lo, 2023). It also allowed the teacher to tailor scaffolding and feedback more effectively, reflecting sociocultural principles of guided support within the learner's zone of proximal development (Aimin, 2013). The small-group format therefore functioned as a pedagogical strength, helping to offset technological and affective challenges commonly associated with online instruction.

Affective Factors: Anxiety and Camera-Off Behavior

A significant affective pattern emerged in the form of periodic camera-off behavior, primarily from one student who appeared hesitant during particular questions. Anxiety is widely recognized as a barrier to second language performance, often reducing learners' willingness to communicate and inhibiting spontaneous interaction (Gass & Selinker, 2008). In online settings, reduced visual presence can further complicate communicative flow by limiting access to nonverbal feedback and emotional cues (Lo, 2023). With the camera off, the teacher had fewer opportunities to interpret learner affect and adjust scaffolding accordingly. Although the learner continued participating verbally at times, the behavior illustrates how affective factors intersect with technological environments to shape communicative engagement.

Technological Disruptions

Technological instability had a persistent impact on the quality of interaction throughout the session. Intermittent audio delays, frozen screens, and brief connectivity losses interrupted the natural rhythm of conversation, forcing participants to repeat or reformulate their utterances. Such disruptions reduce opportunities for sustained negotiation of meaning, a core mechanism of language development (Gass & Selinker, 2008). Research on online learning inequalities similarly highlights how unstable connectivity disproportionately affects learners in low-resource contexts (Kemaloglu-Er & Şahin, 2022). The unpredictability of Myanmar's infrastructure likely increased cognitive load, as learners had to manage both communicative and technical demands simultaneously. Despite these interruptions, participants demonstrated resilience in maintaining engagement.

Successful Implementation of CLT Principles

Despite contextual barriers, the teacher successfully incorporated several core CLT strategies throughout the session, including open-ended questioning, authentic communicative tasks, and scaffolded interaction. These practices align with CLT's emphasis on meaningful communication over isolated grammatical instruction (Nunan, 1991). The teacher's adaptive responses to learner contributions also reflect research suggesting that effective digital tool integration and pedagogical flexibility are central to sustaining engagement in online ESL environments (Sim & Ismail, 2023). Even amid technological instability, the lesson maintained a learner-centered orientation, demonstrating that foundational CLT principles can be upheld in synchronous online settings when instructional practices remain communicatively focused.

Findings and Discussion

Potential of Online CLT

The findings illustrate that CLT can be effectively implemented in an online environment, even in regions experiencing political instability and infrastructural limitations. The learners' willingness to participate and negotiate meaning suggests that synchronous virtual platforms can approximate the interactional benefits of face-to-face instruction when pedagogically structured to prioritize communication. Research indicates that meaningful digital tool integration can support sustained engagement in ESL contexts (Sim & Ismail, 2023). Furthermore, studies examining community-led educational continuity in crisis-affected regions emphasize the growing importance of flexible online instruction in maintaining learning access (Joshi, 2024). Despite contextual constraints, the Zoom-based session provided learners with authentic communicative opportunities that may otherwise be unavailable. These findings reinforce the potential of online CLT as an accessible intervention for learners in marginalized or crisis-affected environments.

Digital Tools as Enhancers of Interaction

The study's results echo existing research indicating that digital tools can enhance engagement and lower affective barriers in online ESL environments. Although this particular session relied primarily on video and audio, there is clear potential for integrating low-bandwidth digital resources such as images, polls, memes, and simple games. Such tools could provide additional communicative prompts and opportunities for learner expression while offsetting the inherent limitations of screen-based communication. Prior research supports the idea that digitally mediated interaction encourages motivation, especially among younger learners who are accustomed to

multimedia environments (Hazar, 2020; Nguyen et al., 2022). Integrating such tools could therefore amplify the communicative affordances of online CLT in fragile contexts.

SLA Theory and Observed Learner Behaviors

Interactionist and sociocultural perspectives offer valuable frameworks for interpreting the communicative patterns observed in the session. Learners' clarification requests, reformulations, and self-corrections reflect negotiation of meaning processes central to second language development (Gass & Selinker, 2008). These interactional adjustments demonstrate how communicative exchanges facilitate noticing and linguistic refinement. Simultaneously, the teacher's modeling and guided prompting align with sociocultural principles of scaffolding within mediated social interaction (Aimin, 2013). However, affective factors—particularly anxiety and camera-off behavior—illustrate potential constraints on these processes, as reduced social presence may limit opportunities for collaborative meaning-making. Together, these findings suggest that while online CLT environments can support core SLA mechanisms, they require deliberate affective and interactional scaffolding to optimize learning outcomes.

Contextual Constraints Unique to Myanmar

The Myanmar context introduces systemic constraints that extend beyond typical online classroom challenges. Unstable electricity supply, inconsistent internet connectivity, and broader sociopolitical uncertainty contribute to heightened stress and unpredictability in learning environments. Research on online learning inequalities highlights how infrastructural limitations disproportionately affect learners in socioeconomically disadvantaged settings (Kemaloglu-Er & Şahin, 2022). Additionally, prolonged exposure to crisis conditions may increase emotional strain for both learners and educators, influencing participation and engagement patterns (Hibbs, 2024). Despite these obstacles, the sustained motivation observed in the session reflects a strong commitment to educational continuity. These findings underscore the importance of context-sensitive pedagogical adaptation when implementing CLT in fragile or conflict-affected environments.

Recommendations

Small-Group Instruction

Maintaining small-group formats in online ESL environments maximizes communicative opportunities by ensuring that each learner receives adequate speaking time and individualized feedback. Research on digital ESL classrooms indicates that reduced student visibility and participation are common challenges in larger online groups (Lo, 2023). Smaller instructional groups help mitigate these issues by fostering more equitable turn-taking and sustained interaction. Additionally, sociocultural theory emphasizes the importance of guided support within manageable interactional spaces, where teachers can scaffold learners effectively within their zone of proximal development (Aimin, 2013). In fragile contexts, small-group instruction may therefore function as both a pedagogical and affective support mechanism, strengthening communicative engagement despite technological instability.

Low-Bandwidth Multimodal Scaffolding

Integrating low-bandwidth multimodal resources can significantly enrich communicative interaction in environments with unstable connectivity. Research suggests that thoughtful digital tool integration enhances engagement when tools are perceived as accessible and manageable (Sim & Ismail, 2023). Simple multimodal elements—such as images,

memes, icons, or text-based prompts—require minimal data yet stimulate meaningful discussion and language production. Studies on digital literacy in ESL contexts demonstrate that visually mediated materials can increase participation while lowering affective barriers (Nguyen et al., 2022). In low-resource settings, such tools offer practical means of sustaining communicative interaction even when bandwidth constraints limit full audiovisual participation.

Affective Support and Camera-Use Flexibility

Providing affective support is essential in online CLT environments where anxiety and self-consciousness may inhibit participation. Second language acquisition research highlights how affective variables can influence learners' willingness to communicate and overall performance (Gass & Selinker, 2008). In online classrooms, reduced nonverbal feedback and social presence can intensify these challenges (Lo, 2023). Teachers should therefore adopt flexible camera-use policies and structured turn-taking strategies that reduce performance pressure while encouraging meaningful interaction. Creating a psychologically safe environment allows learners to take communicative risks, which is fundamental to the successful implementation of CLT principles.

Interactive Digital Tools

The integration of interactive digital tools can enhance communicative learning by increasing motivation and diversifying task types. Research on digital tool adoption in ESL classrooms emphasizes that interactive platforms can support sustained engagement when aligned with pedagogical objectives (Sim & Ismail, 2023). Additionally, studies on digital game-based learning demonstrate positive effects on vocabulary acquisition and learner motivation through playful, goal-oriented interaction (Hazar, 2020). In fragile contexts, even simple interactive activities—such as polls, quizzes, or collaborative documents—can create dynamic communicative opportunities without requiring high-bandwidth infrastructure. These tools align with CLT's emphasis on meaningful language use within authentic, engaging contexts.

Teacher Training for Online CLT

Effective implementation of CLT in online settings requires targeted teacher preparation, particularly for volunteers working in crisis-affected regions. Research indicates that educators often experience increased workload and reduced engagement in digital classrooms when insufficiently trained in online pedagogy (Lo, 2023). Furthermore, inequalities in online learning environments highlight the need for context-sensitive instructional adaptation in low-resource settings (Kemaloglu-Er & Şahin, 2022). Training programs should therefore emphasize strategies for facilitating communicative interaction despite technological disruption, managing small-group dynamics, and providing scaffolding through limited visual cues. Strengthening teacher capacity in these areas will enhance instructional consistency and improve communicative outcomes for learners in fragile educational contexts.

Justification of the Study

Understanding how CLT operates in online environments is essential for improving instructional quality, particularly in fragile contexts where digital learning has become a primary mode of education (Ramzan et al., 2023; Joshi, 2024). This study contributes to the limited literature on online communicative practices in politically unstable regions and provides practical insights for volunteer educators supporting Myanmar learners. Findings may inform the development of more effective, culturally responsive, and

technologically adaptable online ESL pedagogies aligned with CLT principles (Nguyen et al., 2022; Hazar, 2020). By identifying both strengths and limitations of online CLT, the study offers evidence-based recommendations to enhance learner engagement and communicative competence.

Limitations of the Study

This study is limited by its small sample size, as it focuses on a single online ESL session with two adolescent learners, which restricts the generalizability of the findings. Because the session was observed in a naturalistic setting, factors such as inconsistent internet connectivity, environmental distractions, and learner anxiety may have influenced performance independently of instructional approach (Kemaloglu-Er & Şahin, 2022; Hibbs, 2024). Additionally, the study relies on observational data without supplementary interviews or learner reflections, limiting deeper insight into students' internal experiences and motivational factors. As a result, the findings should be interpreted as exploratory, offering contextual understanding rather than broad conclusions about online CLT practices.

Conclusion

This This study examined the implementation of Communicative Language Teaching (CLT) in a Zoom-based ESL lesson for adolescent learners in Myanmar, a context shaped by political instability and technological constraints. The findings demonstrate that meaningful communicative interaction can be sustained in online environments when instruction prioritizes open-ended questioning, scaffolded dialogue, and learner-centered tasks. Despite infrastructural disruptions and affective challenges such as anxiety and camera-off behavior, learners actively negotiated meaning, reformulated responses, and engaged in authentic exchanges. These interactional patterns reflect key principles of Interactionist and sociocultural Second Language Acquisition (SLA) theories, suggesting that core mechanisms of language development remain viable in digitally mediated spaces.

At the same time, the study highlights the persistent influence of contextual constraints. Technological instability disrupted communicative flow, while affective factors limited full participation at certain moments. However, the small-group format and adaptive teaching strategies mitigated many of these barriers, underscoring the importance of flexible, context-sensitive pedagogy in fragile learning environments. Future research should examine multiple online sessions across diverse learner groups to determine whether similar communicative patterns emerge in larger samples. Longitudinal studies exploring the sustained impact of online CLT on communicative competence development in crisis-affected contexts would further strengthen the empirical foundation of this field.

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The Role of Social Media in Developing EFL Learners' Speaking Fluency, Pronunciation, and Confidence in an Exam-Oriented Context

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Abstract

In exam-oriented schools, students often lack the chance to practice speaking English in a meaningful way; however, social media has become an important space where learners engage with the language independently. This study investigates how social media helps students develop their speaking skills in these exam-focused settings, with a focus on fluency, pronunciation, confidence, and exposure to diverse English styles. Using a mixed-methods approach, the study collected data through questionnaires and semi-structured interviews to explore the experiences of EFL students in Guangxi, China. The findings show that social media supports personalized learning by allowing students to practice at their own pace and engage with content they prefer. In particular, participants reported higher confidence and better pronunciation through repeated exposure and the imitation of various English accents. Ultimately, the study concludes that social media acts as a helpful resource that fills the gap left by classroom teaching, offering context-specific strategies to bridge the digital usage gap between urban and rural learners.

Keywords: EFL Speaking Development; Exam-oriented Education; Mixed-methods Study; Personalized Learning; Social Media-mediated Learning

Introduction

Sustainable English is largely a test preparation subject in school systems that emphasize exams. As a result, reading, grammar, and writing are typically the focus of teaching. While these skills are important for grades, students often have very few chances to actually speak English in class.

At the same time, digital technology has created new ways to learn outside of school. Social media platforms like TikTok, Instagram, and YouTube have become popular places for informal learning. By using these apps, students can practice listening to native speakers and copying their pronunciation in a more relaxed environment.

As students move between these two contrasting environments, this research explores social media as a practical tool for oral development. Surveys and interviews provided the data, and they helped the research capture both general feelings and specific personal stories.

Background of the Study

The Gaokao strictly directs English education in China. Classrooms focus heavily on reading and grammar. Speaking practice simply receives less time. This leads many students to achieve high written scores while still struggling with actual conversations. Many learners respond by going online for the practice they miss in class. They frequently use apps like TikTok and YouTube and rely on pop culture to hear real-world English.

As Wardani (2022) and Muh et al. (2023) observe, this move to digital platforms is constantly growing. Following this trend, this research examines how students use these tools to develop their oral skills away from exam-focused instruction.

Review of Related Literature

This study is grounded in theories of second language acquisition and situated within the realities of exam-oriented English education in China. The review first examines how traditional teacher-cantered approaches, particularly grammar-translation practices shaped by high-stakes examinations, influence speaking development. It then discusses relevant SLA theories—including input-based and interaction-based perspectives—that help explain how social media may support informal oral practice. Finally, the section considers personalized digital learning and identifies gaps in research concerning speaking development within exam-driven secondary education contexts.

Exam-Oriented Education and Speaking Development

The demands of the Gaokao heavily shape secondary English classes. Teachers often rely on the Grammar-Translation Method just to manage the strict syllabus. The result is that students tend to view English as a set of rules rather than a real communicative tool. Since speaking is excluded from high-stakes testing, teachers allocate almost all class time to written exercises.

Viewed through the lens of Krashen's (1985) Input Hypothesis, this exam-oriented approach clearly restricts comprehensible input. The high pressure also increases the affective filter (Krashen, 1985), meaning students actively avoid oral practice. Communicative autonomy is severely limited to (Ding & Shen, 2022). When schools ignore oral skills, learners simply look for alternative language applications online (Liu, 2025).

Social Media-Mediated Language Learning

While traditional classrooms often confine students to rigid grammatical instruction, Zhai and Razali (2021) emphasize that effective language acquisition relies on exposure to meaningful, authentic discourse. In this context, digital platforms may provide sustained exposure to comprehensible input (Krashen, 1985). Applications such as TikTok and YouTube provide learners with continuous access to authentic English and diverse accents. Kusumah et al. (2025) and Pham et al. (2023)demonstrate that by engaging with and imitating these multimedia inputs, learners acquire natural phrasing and intonation patterns that are frequently absent from standardized test preparation materials.

Beyond receptive exposure, viewed through the lens of the Interaction Hypothesis, Çolak (2024) and Men (2023) assert that participating in digital interactions—such as leaving comments or recording short videos—provides the low-stakes practice opportunities that formal classrooms often lack. These environments also serve a clear psychological purpose. They easily lower the students' Affective Filter (Parent, 2023; He, 2024).

Heavy exam pressure dominates the traditional classroom, but social media provides a clear alternative. This digital environment completely changes the learning dynamic. Anxiety drops, and learners communicate much more freely.

Dimensions of Speaking Development

In large classes, institutional assessment demands that prioritize standardized, easily graded formats may result in instructional time being devoted primarily to written exercises and structural drills, with limited opportunities for oral production. Students master structural rules but cannot perform basic communicative tasks (Ding & Shen, 2022). This strict focus on accuracy causes fear. It creates a 'freeze effect' and raises the Affective Filter, which stops language learning (He, 2024).

To avoid this stress, learners naturally look at social media. Textbooks often feature stiff dialogue, so students use social apps to hear natural daily speech and slang (Zhai & Razali, 2021; Mudhofar (2023). Long (1996) argues that actual communication is necessary for speaking development. Since traditional, Exam-focused classrooms rarely provide this, digital platforms act as a necessary backup. By leaving comments and making videos, students easily find the low-pressure interaction they need.

Personalized Learning in Digital Environments

Digital platforms may facilitate forms of personalized learning that are less feasible within rigid classroom structures. Instead of following a one-size-fits-all curriculum, students can select videos and materials that match their specific interests. Dewi et al. (2023) highlight this advantage, viewing these online spaces as a practical way for students to take control of their own learning. This is an important shift because, as (Ding & Shen, 2022)point out, students are much more likely to practice speaking when they are genuinely interested in the topic they are discussing.

Conventional classroom structures often require uniform pacing and standardized materials. However, social media provides a different approach. It allows learners to replay a short video as many times as they need or follow content that keeps them engaged. Furthermore, Fan (2023) and Muh et al. (2023) note that this kind of freedom naturally increases student motivation and effort. Such alignment between learning activities and individual interests may enhance learners' motivation and engagement.

Research Gap

Prior research shows that social media supports learning, but high-stakes exams continue to limit actual speaking. This leaves an unresolved gap that this study needs to fill. Since scholars like Aloraini and Cardoso (2020) and Dewi et al. (2024) primarily focus on the university context, their findings reflect learners with high levels of autonomy. However, these patterns may not apply to teenagers struggling under the pressure of the Gaokao. Consequently, the high school environment—where exam pressure is much more intense—is often overlooked. Currently, there is limited empirical evidence showing how these applications actually affect a teenager's fluency and confidence when their daily schooling is strictly focused on test preparation. Even though Liu (2025) and Li et al. (2018) suggest that digital platforms can fill in this missing speaking practice, more direct research is needed to understand exactly how secondary students integrate these tools into exam-oriented learning contexts.

Research Questions

A key concern is that speaking practice remains secondary in exam-oriented high schools. Since the Gaokao primarily tests reading and grammar, teachers typically allocate classroom time to test preparation. Wardani (2022) notes that digital apps support independent practice. However, such studies frequently focus on university students with flexible schedules. This reveals a clear gap in the existing literature: it remains unclear whether these digital tools effectively help teenagers who operate under intensive exam demands. Additionally, as Liu (2025) explains, students' locations often impact their access to online resources. Therefore, mobile apps do not offer a universal solution for everyone. Driven by these realities, this study aims to determine whether mobile applications can supplement the limited speaking opportunities in strict, test-driven classrooms.

Therefore, this study focuses on two main questions:

- How does social media influence the speaking skills of English learners in exam-focused high schools?
- In what ways does social media act as a tool to fill the gaps left by classroom instruction?

Methodology

This study employed a structured mixed-methods approach to examine how social media influences EFL learners' speaking development and how it compensates for limitations in exam-oriented classroom instruction. The methodological design was aligned closely with the two research questions to ensure both analytical depth and contextual relevance.

Research Design

The study applied a concurrent mixed-methods approach, collecting quantitative and qualitative data simultaneously. Creswell and Plano Clark (2018) describe mixed-methods research as an approach that integrates numerical patterns with personal experience. Speaking development involves both measurable change and individual perception. Survey data provided quantitative patterns of reported improvement, while interview data offered qualitative explanations for these patterns.

Research Question 1 is answered using the survey data on fluency, pronunciation, and confidence. To address Research Question 2, the interviews explore social media as an out-of-class support. These two methods naturally cover each other's blind spots. Because the survey and interviews support each other, the final analysis becomes much more complete. (Creswell & Plano Clark, 2018).

Research Context and Participants

The study was conducted in Guangxi, China, a region heavily driven by the Gaokao exam system. Ninety students aged 13 to 18 took the survey. Most of these participants had studied English for more than four years. After the survey, five students attended the interviews. They were purposively chosen to represent different school backgrounds (urban and suburban) and different social media habits. The Gaokao primarily tests reading and grammar skills. This range allows the study to present varied experiences rather than a single perspective.

Questionnaire Development

Scholars such as (Aloraini & Cardoso,2020) and Zhai and Razali (2021) evaluate digital language learning through core dimensions, including fluency, pronunciation, confidence, and learner autonomy. They identify these elements as critical factors for successful language learning. The questionnaire was developed based on these four dimensions. It targeted the influence of social media on speaking skills in contexts characterized by exam-focused instruction.

For the question format, Fauziah and Sutrisno (2024) present a simple Likert scale as the standard tool. In their view, it reliably measures how students feel about their progress. A five-point Likert scale was employed for data collection. The questionnaire underwent expert review to ensure clarity and comprehensibility prior to distribution.

Interview Sampling and Procedure

Creswell and Plano Clark (2018) argue that exploring survey data requires participants from diverse backgrounds. Based on this idea, five students were selected for the interviews to capture a broad range of experiences. The participants included a student from a top city school, one from the suburbs, and others who use English apps primarily for recreational purposes.

For the interview format, Dewi et al. (2023) recommend a semi-structured style. They recommend a flexible conversation format to capture detailed personal experiences related to online learning. A semi-structured format was employed for the interviews. Each session lasted between 20 and 30 minutes. The discussions not only addressed changes in pronunciation and confidence but also examined students' experiences using English-learning applications in comparison with traditional exam-focused classrooms. All sessions were recorded and fully transcribed for analysis.

Data Collection Procedure

Creswell and Plano Clark (2018) argue that survey results should guide the follow-up interviews. The study followed this sequence in data collection, beginning with the questionnaire. It was distributed online, enabling the collection of 90 responses from students who frequently use mobile devices.

Once the main survey trends emerged, five students were invited to the interviews. These 20-minute sessions were scheduled during lunch breaks and weekends to accommodate students' preparation for the Gaokao. All participant information was kept completely private. This secure setup allowed students to feel safe discussing their actual experiences. They talked about their school stress very honestly, and they openly shared how they use these platforms.

Analysis

Descriptive statistics from the 90 survey responses were analyzed to track frequency patterns related to pronunciation and confidence. an analytical approach that aligns with Fauziah and Sutrisno (2024).

Interview data were analyzed through manual thematic analysis following Braun and Clarke (2006). Repeated readings of the transcripts moved the focus from general answers to specific student realities. The integration of quantitative survey results with qualitative

interview themes provided a comprehensive account of students' speaking development and daily learning experiences.

Findings and Discussion

An initial review of the survey data shows a broadly positive pattern across all 90 students. Most participants linked their social media use to better spoken English. These shifts are detailed in Table 1, with a strong focus on fluency and pronunciation awareness. The data also reveals a higher general interest in learning.

Table 1 Students' Perceptions of Social Media on Oral Proficiency

Categories	Survey Items	%Agreed/Strongly Agreed
Usage & Preference	Use social media to practice speaking	72.22%
	Prefer social media over textbook drills	67.78%
Fluency & Skills	Social media helps improve pronunciation	75.56%
	My speaking speed has improved	69.00%
	I pause or hesitate less when speaking	62.22%
Affective Factors	I feel more confident online than face-to-face	70.00%
	I feel less nervous in class after online practice	65.56%

Social Media as an Informal Speaking Extension As shown in Table 1, 72.22% of the participants use social media to practice speaking, indicating a noticeable change in how they study daily. Digital platforms—like short videos and interactive clips—frequently replaced traditional textbook exercises for speaking practice. Although digital apps are popular, they haven't completely replaced traditional materials. Some students simply prefer sticking to their textbooks.

This mixed picture makes sense alongside recent literature. Wardani (2022) and Pham et al. (2023) suggest that digital platforms enhance learner autonomy; this aligns with the current finding that students attribute their increased confidence to the freedom of selecting their own content. Also, Zhai and Razali (2021) emphasize the need for meaningful communication. For these specific learners, social media clearly offers that vital communicative practice to balance out standard, exam-oriented classroom routines.

Repetition and Implicit Pronunciation Training

The interview transcripts help explain the high survey numbers. During the sessions, participants reported that speaking to a phone screen was less intimidating than speaking to a teacher who constantly looks for mistakes. Many students described these apps as an alternative space separate from the structured demands of school schedules. They also reported picking up slang and real-world accents that rarely appear in traditional classrooms. Despite differences in technological access, almost all interviewed students found ways to maintain this daily practice.

These personal accounts connect directly to existing research on learning anxiety. He (2024) and Parent (2023) observe that a lowered "Affective Filter" helps students relax and start speaking. The interview data reflects this effect, as the digital environment

removes the immediate fear of correction. Also, Mudhofar (2023) and Wardani(2022) argue that informal practice naturally leads to better conversational skills. The students' exposure to slang and authentic accents supports this idea. While Liu (2025) points out that technical resources vary among learners, the motivation to practice remains consistent. Ultimately, these findings indicate that students actively engage in meaningful communicative practice beyond exam-focused instruction.

Low-Stakes Practice and Confidence Development

Both the survey and interviews point to social media as a safe, low-pressure space. Most of the 90 surveyed students felt much more confident practicing behind a screen because there is no formal grading. And importantly, this online comfort later improved their actual classroom performance. The specific interview sessions really unpack this change. Watching "imperfect" English videos on Douyin shifted Hui's focus from grammatical perfection to actual communication. Similarly, digital platforms helped Lin see the language as a practical skill instead of just another exam requirement.

These personal stories show exactly how a low-stakes environment helps students build a stronger "English-speaking self." This practical observation aligns with He (2024) and Fauziah and Sutrisno (2024). The digital screen provides a safe buffer, and this clearly cuts down the fear of public failure. For students in a strict exam system, the digital environment provides opportunities for risk-free practice. As Parent (2023) suggests, this newfound confidence eventually provides the courage needed for real-world situations. Overall, these platforms enabled focus on authentic communication rather than accuracy alone.

Personalized Learning Within Exam-Oriented Systems

The survey and interview results show that while Guangxi’s classrooms remain highly exam-focused, social media provides opportunities for practice outside exam-focused classrooms. A majority of the surveyed students reported that these platforms helped them start thinking directly in English, rather than translating every word from Chinese in their heads. However, a noticeable group remained neutral about these benefits. The interview sessions provided clarity on this gap, revealing that a little teacher support makes a major difference. Xiang’s experience provides an example. She mostly used Redbook (Xiaohongshu) for entertainment until her teacher shared specific pronunciation videos on the app. Once she knew what to look for, the ability to hit "replay" and learn at her own pace was associated with more effective self-paced learning compared with classroom lectures.

Evaluating these practical results alongside existing research highlights a key limit of digital learning. The neutral students prove that social media does not automatically work for everyone; students still require some direction to use it well (Ding & Shen, 2022). Xiang’s story adds specific context here, which aligns with Fan (2023) and Men (2023), who found that teacher validation is crucial for personalized learning. These findings simply suggest that a small amount of teacher guidance makes social media a much stronger supplementary tool.

Pedagogical Implications

The findings indicate that social media holds considerable potential; however, its actual impact appears to vary depending on students’ regional contexts. Even where hardware is available in rural schools, a persistent usage gap remains because, as Liu (2025) and Li

et al. (2018) suggest, students often have the devices but don't know how to use them for more than just games. Therefore, the study prioritizes context-sensitive and practical strategies that can be realistically implemented in schools.

Instructional Practice: Adapting Tasks to Local Realities

Findings indicate that task design should consider school technology, as Dewi et al. (2023) suggest. For classrooms lacking individual devices, the main projector serves as the central learning tool. Teachers can introduce "Choral Dubbing." Instead of asking one student to speak alone, the entire class repeats a short video clip collectively. This collective practice effectively lowers speaking anxiety. It allows students to test pronunciation and rhythm without the pressure of individual performance.

In schools with better technology access, the main challenge is moving students from passive watching to active production. A 'Creative Output' approach works well for these specific classrooms. Students record 'contrastive role-play' videos to practice speaking. They first act out a common English mistake, and then they show the correct phrase. This specific task brings Çolak's (2024) theory into actual classroom practice. It forces learners to be creators, so they carefully check their own language before speaking.

Curriculum Reform: Aligning Exams with Digital Literacy

The curriculum should connect formal exams with actual online communication. Achieving this requires a shift from static text to multimedia resources. Linking pop culture to the Gaokao syllabus offers a simple, practical bridge. Students analyze movie clips to find specific test phrases, and this easily replaces the endless memorization of rules. This simply shows that real-world English and high-test scores can go hand in hand.

For students in rural areas with limited resource access, the curriculum should provide structured guidance. Li et al. (2018) notes that explicit direction works better than independent searching for these students. Putting QR codes in standard textbooks easily solves this problem. These codes can link directly to high-quality educational accounts. This official inclusion guides students to use their phones productively. As Muh et al. (2023) suggest, such integration turns a potential digital distraction into a valuable tool. It helps students balance their daily online habits with formal schoolwork.

Policy Advocacy: Formalizing Informal Digital Learning

Policy makers should do more than just approve digital learning. Since rural students often lack personal devices, converting current computer rooms into 'English-Speaking Labs' is a highly practical step. This approach follows Li et al. (2018), who argue that institutional resources are essential for supporting under-resourced learners. By opening these labs every week, schools give students a safe space to practice, which offers a low-cost method to improve digital access.

Departments of education should also develop a 'cloud library' filled with micro-learning clips. Since long lectures are easily ignored today, these official resources need an influencer-like style. For example, a school platform could post simple 2-minute grammar 'hacks.' This method delivers the exact same curriculum, so students actually watch and learn. As Bu, Pan, and Wang (2025) note, instructional clips should balance entertainment with academic accuracy. As Liu (2025) warns, without an official "content bank," rural students face a continuous disadvantage compared to urban peers who possess greater

resource access. Therefore, providing targeted digital content is likely to help narrow the educational gap.

Limitations

The data highlights a clear shift in student confidence, but the context remains highly specific. As the findings come entirely from rural Guangxi, they reflect a specific environment with limited resources. Urban learners typically have stronger digital support at home, so their online learning habits might look completely different. Also, a one-semester study mainly reveals short-term motivation. This short window captures the initial excitement of using social media, but it cannot tell us if these speaking habits survive the actual pressure of the final Gaokao.

Self-developed Instrument

The study utilized a self-developed questionnaire tailored to secondary schools in Guangxi. This design aligns with Li et al. (2018), who emphasizes the need for research tools that fit the reality of rural classrooms. While an expert review helped refine the initial questions, time and logistical limits prevented a formal pilot study.

Omitting this step left the survey without a preliminary reliability test. Creswell and Plano Clark (2018) observe that smaller studies frequently face this exact compromise. Still, without a trial run, certain items might have remained confusing for the students. A proper pilot study would have identified and resolved these hidden ambiguities prior to the main data collection.

Convenience Sampling and Sample Size

Relying on a convenience sample of 90 students represents a notable limitation of this study. Although the group included both urban and rural learners, the small sample size cannot fully represent the broader student population across Guangxi. In addition, voluntary participation introduces an inherent self-selection bias. Students who opted to join were likely not typical learners; they tended to be more comfortable with digital platforms and exhibited higher intrinsic motivation to practice English.

(Aloraini & Cardoso, 2020) and Men (2023) identify this inherent self-selection bias as a pervasive challenge in digital learning research. Due to this bias, the positive findings might appear more optimistic than the reality of the general student body. Ultimately, these participants reflect the most active learners rather than the average student.

Regional Focus

Focusing exclusively on Guangxi limits the study to a highly specific linguistic and economic setting. The students' Zhuang or Cantonese backgrounds often caused them to mix up /n/ and /l/ sounds. Beyond pronunciation, Liu (2025) highlights the economic limits of southwestern China. Classroom observations often revealed groups of four or five students sharing a single borrowed smartphone to practice speaking. These exact technology and pronunciation issues differ from wealthier cities like Shenzhen, where students typically use personal devices and face different linguistic hurdles. The findings primarily apply to other under-resourced areas where strong local dialects and restricted screen access influence language acquisition outcomes.

Reliance on Self-reported Data

Rather than conducting objective speaking tests, the study based its findings entirely on self-reported data. Fauziah and Sutrisno (2024) and Pham et al. (2023) note that this is a common challenge in this type of research. As a result, reported gains in fluency and speed depend entirely on student perception. Students often feel they have improved significantly once they gain speaking confidence. But this increased confidence does not automatically guarantee better grammar (He, 2024). Many participants became more fluent in class, and they still made basic errors. Without baseline pre-tests, true language development remains unmeasured. The findings simply highlight a boost in confidence, not verified linguistic progress.

Conclusion

Social media clearly acts as a practical tool in Guangxi. It connects exam prep to real communication, and this low-pressure practice reduces student anxiety. As a result, the classroom "freeze effect" was significantly mitigated. A distinct usage gap also appeared. While urban students use these tools to create their own content, rural students mostly remain passive watchers. Since giving out devices is not enough, teachers need to show students how to use them productively.

Looking ahead, future research must move beyond self-reported feelings. Due to the limited timeframe of the current research, it remains unclear whether this confidence persists during actual examinations. Finally, comparing developing regions like Guangxi to wealthier urban centers like Shanghai would provide valuable insights into how family income and home environments shape digital learning. In the end, the main goal goes beyond pushing technology into classrooms. It is about making sure geography no longer limits speaking opportunities.

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Explicit Essay Structure Instruction and Sentence-Level Errors in Arabic EFL Writing

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Abstract

Arabic-speaking learners of English as a Foreign Language (EFL) frequently experience difficulties in persuasive writing due to challenges in managing rhetorical organization while maintaining sentence-level grammatical accuracy. These difficulties often manifest in clause-boundary errors such as run-on sentences and comma splices, which are partly influenced by cross-linguistic differences between Arabic and English rhetorical patterns. This study investigates whether explicit instruction in persuasive essay structure can reduce sentence-level errors in Arabic-speaking EFL writing. A quantitative quasi-experimental pre-test/post-test design was employed involving 60 intermediate-level Arabic-speaking undergraduates enrolled in an Intensive English Program at a Malaysian private university. Participants received a six-week instructional intervention known as the Essay Structure–Instructional Strategy (ESIS), which explicitly taught the macro-structure of persuasive essays and linked rhetorical components to relevant grammatical forms. Sentence-level errors in persuasive essays were analyzed using a structured error taxonomy and normalized per 100 words. Statistical analysis using a paired-samples t-test revealed a significant improvement in sentence-level accuracy following the intervention. The total number of sentence-structure errors decreased from 457 in the pre-test to 298 in the post-test, representing a 34.79% reduction. The most substantial improvements were observed in comma splices (51.75%) and run-on sentences (37.89%), while more moderate reductions occurred in subject–verb agreement and modifier placement errors. Mean writing scores also increased significantly from 20.50 to 25.80 ($p < .05$). The findings suggest that explicit macro-structural scaffolding can indirectly enhance micro-level grammatical control by reducing cognitive load during writing. The study highlights the pedagogical value of integrating essay organization and grammar instruction in EFL writing pedagogy for Arabic-speaking learners.

Keywords: Arabic-Speaking EFL Learners; Essay Structure Instruction; Persuasive Writing; Sentence-Level Errors

Introduction

Writing proficiency is a critical component of academic success in higher education, particularly for learners of English as a Foreign Language (EFL), whose achievement is often assessed through argumentative and persuasive writing. Academic writing requires not only grammatical accuracy but also effective organization and adherence to genre conventions (Hyland, 2004). For EFL learners, developing these skills represents both a linguistic and cognitive challenge (Abdelmohsen, 2022).

Despite prolonged exposure to formal English instruction, many EFL learners continue to experience difficulties in academic writing. These challenges are especially pronounced among Arabic-speaking learners, who frequently struggle with sentence-level accuracy, including grammatical errors and non-target-like sentence structures, as well as with organizing ideas coherently in English (Scott, 1974; Abdel Latif et al., 2024). Such difficulties can negatively affect the clarity and effectiveness of their persuasive writing.

A key source of these problems lies in the linguistic and rhetorical differences between Arabic and English (Kaplan, 1966). At the sentence level, differences in verb tense usage, copular constructions, and word order often result in systematic grammatical errors in English writing (Mukattash, 1986; Ahmed et al., 2020). At the discourse level, Arabic rhetorical patterns tend to favor coordination and circular development of ideas, whereas English academic writing emphasizes linear organization and explicitly structured arguments (Connor, 1996; Ahmed et al., 2023). The transfer of Arabic rhetorical conventions into English persuasive essays may therefore contribute to both organizational weaknesses and sentence-level errors (Hinkel, 2004; Ait Aissa & Chami, 2023).

Traditional writing instruction in many EFL contexts has focused primarily on grammar correction and sentence-level drills (Truscott, 1996). While such approaches may increase learners' awareness of grammatical rules, they often fail to integrate form with rhetorical purpose and overall text organization (Han & Selinker, 1996; Alghazo & Alshraideh, 2020). From a cognitive perspective, writing is a demanding activity that requires learners to manage planning, organization, and language production simultaneously. When learners lack control over essay structure, their cognitive resources may be overloaded, resulting in increased sentence-level errors (Al-Hamzi et al., 2023; Kellogg, 1996).

Recent pedagogical approaches suggest that explicit instruction in genre and essay structure can reduce this cognitive burden by providing clear organizational frameworks (Alqasham et al., 2021). In persuasive writing, guidance on the functions of introductions, thesis statements, body paragraphs, and conclusions may allow learners to allocate greater attention to sentence construction and grammatical accuracy. However, despite growing interest in structure-based instruction, empirical evidence examining its direct impact on sentence-level errors—particularly among Arabic-speaking EFL learners—remains limited (Bitchener & Ferris, 2012; Alrouji, 2020). Most existing studies emphasize overall writing quality or coherence rather than specific grammatical outcomes (Al-Rickaby, 2023).

In the context of digital transformation in education, structured writing instruction can also complement emerging AI-assisted writing tools. Many AI-based platforms provide automated feedback on grammar and sentence structure; however, they often focus primarily on micro-level linguistic accuracy rather than rhetorical organization. Explicit instruction in essay structure equips learners with foundational organizational strategies that can work synergistically with AI-driven feedback systems. By combining human-guided structural instruction with AI-supported error detection, EFL learners may benefit from more comprehensive support in developing both rhetorical coherence and sentence-level accuracy.

Review of Related Literature

Writing in English as a Foreign Language (EFL) is widely recognized as a complex academic skill that integrates linguistic accuracy, cognitive processing, and rhetorical organization (Hyland, 2003). In higher education, academic writing—particularly persuasive and argumentative writing—is a primary means of assessment, and EFL learners often struggle to produce texts that are both grammatically accurate and rhetorically coherent (Betti & Bsharah, 2023). Research indicates that these difficulties cannot be attributed to grammatical knowledge alone but arise from the interaction of language proficiency, task demands, and instructional support (Kellogg, 1996). Among Arabic-speaking EFL learners, persistent sentence-level errors such as subject–verb agreement problems, copula omission, tense misuse, and non-target-like word order have been extensively documented and are commonly linked to first language transfer, particularly the absence of an overt present-tense copula in Arabic (Scott & Tucker, 1974; Mukattash, 1986; Hinkel, 2004). These errors are especially prevalent in persuasive writing, where learners attempt longer and more complex sentences to express logical relationships (Chaudhary & Al Zahrani, 2020).

From a contrastive rhetoric perspective, differences between Arabic and English rhetorical traditions further contribute to learners' writing difficulties, as Arabic discourse often favors coordination and elaboration, whereas English academic writing emphasizes linear organization and explicit argument structure (Daweli, 2020; Kaplan, 1966; Connor, 1996). Cognitive Load Theory offers an additional explanation by suggesting that uncertainty about text organization increases cognitive demands, leaving fewer resources available for grammatical monitoring (Sweller, 1998; Kellogg & Whiteford, 2009). Genre-based and structure-focused instructional approaches address this issue by making rhetorical conventions explicit and have been shown to improve coherence and overall writing quality (Hyland, 2007; Derakhshan & Karimian Shirejini, 2020). However, despite their documented macro-level benefits, empirical evidence examining whether such instruction leads to reductions in specific sentence-level error types—particularly among Arabic-speaking EFL learners—remains limited (Bitchener & Ferris, 2012). The present study addresses this gap by examining the impact of explicit persuasive essay structure instruction on sentence-level errors in Arabic-speaking EFL writing.

This study is informed by process-oriented writing theory and principles of cognitive scaffolding in second language learning. Process writing approaches emphasize the structured development of ideas through stages of planning, drafting, and revision, allowing learners to gradually refine both rhetorical organization and linguistic accuracy. From a cognitive perspective, scaffolding theory suggests that explicit structural guidance can reduce cognitive load during writing tasks. When learners are provided with clear rhetorical frameworks—such as thesis statements, supporting arguments, and counterarguments—they can allocate greater cognitive resources to sentence construction and grammatical accuracy. In this way, macro-level structural instruction may indirectly support improvements in micro-level sentence formation.

Objectives

This study seeks to examine the relationship between explicit instruction in persuasive essay structure and the reduction of sentence-level errors in the writing of Arabic-speaking learners of English as a Foreign Language (EFL). Although many EFL learners possess sufficient vocabulary to convey their ideas, they frequently encounter difficulties in organizing their arguments logically while maintaining grammatical accuracy at the

sentence level. In particular, learners often produce errors involving coordination, subordination, punctuation, and sentence boundaries, which can negatively affect the clarity and coherence of their written arguments. These challenges may be further influenced by rhetorical and syntactic differences between Arabic and English, which can shape learners' writing patterns.

Within this context, the present study focuses on whether providing explicit guidance on the organizational structure of persuasive essays—such as the introduction, thesis statement, supporting arguments, counterarguments, and conclusion—can indirectly improve learners' control over sentence construction. When students are given clear structural frameworks for organizing their ideas, cognitive load during writing may be reduced, allowing them to allocate greater attention to grammatical accuracy and sentence formation. Consequently, the study aims to determine whether instruction that emphasizes macro-level essay organization can contribute to measurable improvements at the micro-level of sentence structure.

Accordingly, the study is guided by the following research question of to what extent does explicit instruction in persuasive essay structure reduce sentence-level errors in the writing of Arabic-speaking EFL learners?

Methodology

Research Design

This study employed a quantitative quasi-experimental pre-test/post-test design to investigate the effect of explicit persuasive essay structure instruction on sentence-level errors in EFL writing. This design is commonly used in education research when random assignment is not feasible due to institutional or curricular constraints. By comparing learners' writing performance before and after an instructional intervention, the design allows for the identification of changes that can be reasonably attributed to the treatment (Cook & Campbell, 1979).

The independent variable was explicit instruction in persuasive essay structure, implemented through the Essay Structure–Instructional Strategy (ESIS). The dependent variable was sentence-level accuracy, operationalized as the frequency of grammatical and structural errors in learners' persuasive writing. This focus on observable linguistic outcomes aligns with empirical traditions in educational research that emphasize measurable learning gains (Mukattash, 1986; Norris & Ortega, 2000).

While the pre-test/post-test design allows for the examination of changes in sentence-level errors following instruction, the absence of a control group limits the strength of causal inference. Without a comparison group receiving traditional instruction, it is not possible to attribute improvements solely to the explicit essay-structure intervention. Nevertheless, the design provides preliminary evidence of instructional effectiveness and offers a basis for future experimental studies employing randomized or controlled group comparisons.

Participants and Educational Context

The participants were 60 undergraduate students enrolled in an Intensive English Program at a private university in Malaysia. All participants were native speakers of Arabic originating from various Middle Eastern countries and were studying English as a Foreign

Language for academic purposes. Based on institutional placement tests and course requirements, their proficiency levels were classified as intermediate (CEFR B1–B2).

The Malaysian higher education context is characterized by increasing international student mobility and a strong emphasis on English-medium instruction (Ali & Mahmud, 2018). Within this context, Arabic-speaking students are required to demonstrate competence in academic writing to progress in their studies (Alqasham et al., 2021). Participation in the study was voluntary, and students were informed that their course grades would not be affected by their decision to participate or withdraw.

Analysis

Instructional Intervention: Essay Structure–Instructional Strategy (ESIS)

The instructional intervention was conducted over a six-week period and integrated into the participants' regular writing classes. The Essay Structure–Instructional Strategy (ESIS) was designed to provide explicit guidance on the macro-structure of persuasive essays while systematically linking structural components to sentence-level grammar (Liu et al., 2024).

The intervention comprised three instructional phases. The first phase, the Blueprint Phase, introduced students to the conventional structure of persuasive essays, including introductions with clear thesis statements, body paragraphs organized around topic sentences and supporting details, and conclusions that restate and reinforce the main argument. This phase emphasized the communicative function of each section rather than rote adherence to a formula.

The second phase, the Functional Grammar Phase, explicitly connected essay sections to the grammatical structures typically required to fulfill their rhetorical purposes. For example, students were taught how copular constructions are commonly used in thesis statements, how complex sentences and cohesive devices support argument development in body paragraphs, and how modality and summarizing structures are used in conclusions. Grammar instruction was therefore embedded within authentic writing tasks rather than taught in isolation (Pham & Bui, 2022; Khan, 2022).

The final phase, the Revision Phase, focused on self-monitoring and self-editing. Students were trained to use essay structure as a checklist when revising their drafts, ensuring that each paragraph served its intended rhetorical function and that sentence structures were grammatically appropriate. This phase aimed to foster learner autonomy and reflective writing practices, which are key goals in contemporary EFL education (Hyland, 2000; Liu & Ahmad, 2024).

Instruments and Data Collection

Data were collected using a pre-test and post-test that formed the quantitative component of the study's quasi-experimental design. The instruments, identically titled *WRITING ERROR ANALYSIS* and each allocated 40 marks, were designed to assess sentence-level accuracy in persuasive writing. The pre-test established a baseline of participants' sentence structure proficiency, while the post-test, administered after the instructional intervention, enabled direct comparison to evaluate the effect of explicit essay structure instruction. Both tasks required participants to produce persuasive responses on familiar educational or social topics, ensuring consistency in genre and task demands.

All writing tasks were completed in the classroom under controlled conditions and written by hand on paper. The scripts were anonymized prior to analysis, and sentence-level errors were identified using a consistent error analysis framework. To control for variation in text length, error frequencies were normalized per 100 words. Quantitative data were analyzed using descriptive statistics and a paired-samples t-test to determine whether changes in sentence-level accuracy from pre-test to post-test were statistically significant.

Error Coding and Data Analysis

A structured error taxonomy was developed to categorize sentence-level errors commonly observed in Arabic-speaking EFL writing. The taxonomy included subject–verb agreement errors, copula omission, word order errors related to the subject–verb–object structure, and sentence boundary errors such as run-on sentences and fragments. These categories were selected based on prior research and their relevance to the instructional focus of the intervention.

Each input was manually coded, and error frequencies were recorded for each category. Descriptive statistics were used to calculate mean error rates for the pre-test and post-test. Inferential statistical analysis was then conducted to determine whether observed differences were statistically significant. This approach allowed the study to identify both overall trends and category-specific changes in sentence-level accuracy.

Ethical Considerations

Ethical considerations were central to the design and implementation of this study. Prior to data collection, participants were provided with detailed information about the purpose of the study, the procedures involved, and their rights as participants. Informed consent was obtained from all participants, and they were assured that participation was entirely voluntary.

Participants were informed of their right to withdraw from the study at any point without penalty or negative consequences. To protect confidentiality and anonymity, all identifying information was removed from the data, and participants were assigned numerical codes. Electronic data were stored on password-protected devices, and access was restricted to the researcher. All collected data were used solely for academic research purposes in accordance with institutional ethical guidelines.

Findings and Discussion

Baseline Error Profile

Analysis of the pre-test persuasive essays (N = 60) revealed a total of 457 sentence-structure errors. Errors were categorized into five structural types. Run-on sentences (35.23%) and comma splices (24.95%) constituted the majority of errors, together accounting for over 60% of all observed structural inaccuracies. Additional error categories included missing or incorrect phrasal prepositions (19.69%), incorrect adverbial or adjectival placement (14.22%), and subject–verb agreement errors (5.91%). The predominance of clause-boundary errors suggests that difficulties in coordinating and subordinating clauses represent the primary structural challenge for this learner population prior to intervention.

Table 1 Frequency of Sentence Structure Error Types

Rank	Sentence Structure Error Type	Brief Explanation	Total Frequency (n = 457)	Percentage of Total Errors
1	Run-on Sentences	Occurs when two or more independent clauses are joined together without proper punctuation or conjunctions. The sentence continues too long without a clear break.	161	35.23%
2	Comma Splices	Occurs when two independent clauses are incorrectly joined using only a comma, instead of a semicolon, a coordinating conjunction or a period.	114	24.95%
3	Missing or Incorrect Phrasal Prepositions	Errors involving two or more words that function as a preposition, such as idiomatic expressions or phrasal verbs. The learner either omits the preposition or uses the wrong one.	90	19.69%
4	Incorrect Adverbial or Adjectival Placement	Errors where modifiers are placed incorrectly, leading to dangling modifiers or misplaced modifiers. This obscures the intended meaning of the sentence.	65	14.22%
5	Subject-Verb Agreement Errors	Occurs when the verb does not correctly match its subject in number (singular or plural). For example, a singular subject is incorrectly paired with a plural verb form.	27	5.91%
TOTAL			457	100.00%

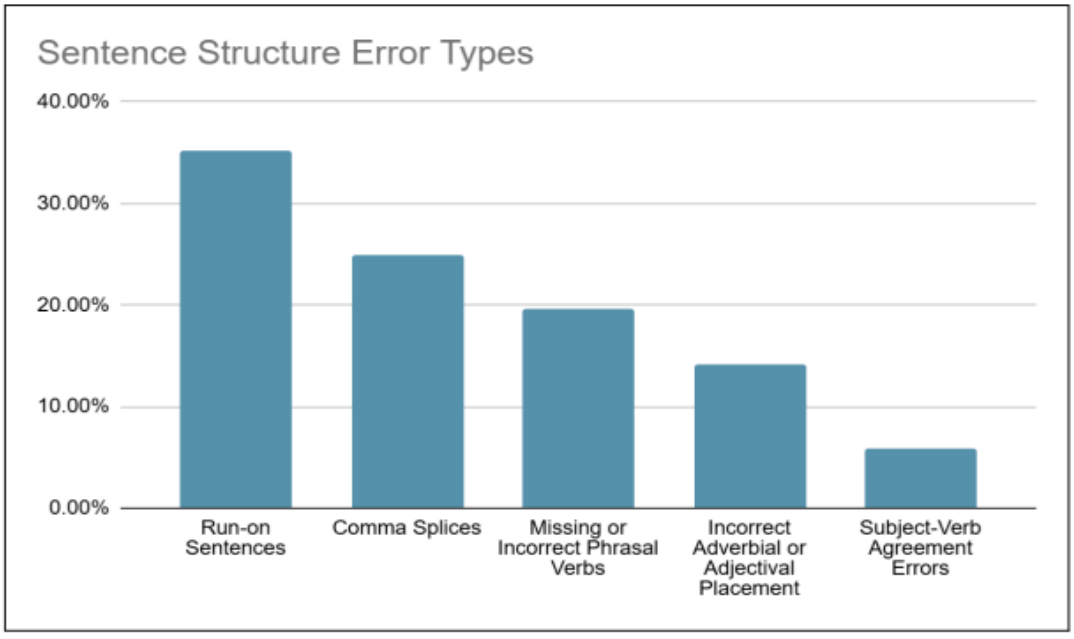

Figure1 Frequency of Sentence Structure Error Types

Effect of the ESIS Intervention

Post-intervention analysis demonstrated a substantial reduction in sentence-structure errors. The total number of errors decreased from 457 to 298, reflecting an overall reduction of 34.79%. The most pronounced improvement was observed in comma splices (51.75% reduction), followed by run-on sentences (37.89%). More moderate reductions

were noted in subject–verb agreement errors (25.93%), missing or incorrect phrasal prepositions (24.44%), and incorrect modifier placement (15.38%).

These findings indicate that the intervention was particularly effective in addressing clause-boundary violations. Quantitative score analysis further confirmed the effectiveness of the intervention. Mean sentence-structure scores increased from 20.50 (SD = 5.23) in the pre-test to 25.80 (SD = 5.09) in the post-test. Results indicate a statistically significant reduction in overall sentence-level errors following the instructional intervention ($p < .05$). Improvements were observed across several error categories, suggesting that explicit essay-structure instruction contributed to greater sentence-level accuracy.

Table 2 Comparison of Pre-Test and Post-Test Errors

Sentence Structure Error Type	Pre-Test Errors (*n*=457)	Post-Test Errors (*n*=298)	Reduction in Errors	Percentage Reduction
Run-on Sentences	161	100	61	37.89%
Comma Splices	114	55	59	51.75%
Missing or Incorrect Phrasal Prepositions	90	68	22	24.44%
Incorrect Adverbial or Adjectival Placement	65	55	10	15.38%
Subject-Verb Agreement Errors	27	20	7	25.93%
TOTAL	457	298	159	34.79%
Average	7.62	4.97	2.65	34.78%

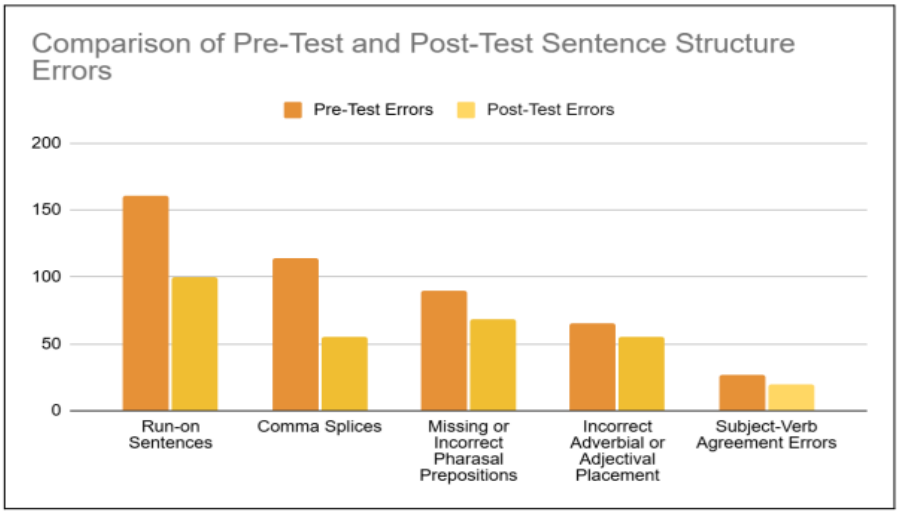

Figure2 Frequency of Sentence Structure Error Types

Analysis and Discussion

The findings provide robust empirical support for the effectiveness of explicit essay structure instruction in improving sentence-level accuracy among Arabic-speaking EFL learners. The statistically significant increase in post-test scores, combined with the 34.79% overall reduction in structural errors, indicates that the intervention had both statistical and pedagogical significance. Notably, the most substantial reductions occurred in run-on sentences and comma splices - error types strongly associated with L1 rhetorical transfer. The targeted decline in these boundary-related errors suggests that macro-level structural instruction may function as an indirect mechanism for enhancing micro-level grammatical control. By providing a fixed rhetorical blueprint, the ESIS likely reduced cognitive load associated with organizing persuasive arguments, thereby allowing learners to allocate greater attentional resources to sentence construction and boundary monitoring (RahmtAllah, 2020).

Qualitative findings further corroborate this interpretation. Participants reported that the structured essay framework reduced planning ambiguity and facilitated conscious monitoring of L1 transfer patterns. Learners also described increased confidence in regulating sentence boundaries and grammatical forms, reflecting enhanced grammatical self-efficacy.

Taken together, the quantitative and qualitative evidence suggests that explicit macro-structural scaffolding can serve as an effective intervention for addressing persistent sentence-boundary errors among Arabic-speaking EFL learners. These findings support an integrated pedagogical model in which rhetorical organization and grammatical accuracy are treated as interdependent dimensions of L2 writing development (Scott & Tucker, 1974; Sweller, 1998; Nguyen & Truong, 2024; Yu, 2021).

Future research should employ controlled experimental designs and explore the integration of AI-assisted writing feedback systems to further examine how structural instruction and digital tools jointly support EFL writing development.

The findings demonstrate that explicit essay structure instruction (ESIS) produces a statistically significant and pedagogically meaningful improvement in sentence-level accuracy among Arabic-speaking EFL learners. The 34.79% overall reduction in structural errors, alongside a 5.30-point gain in assessment scores ($t(59) = 8.01$, $p < .001$, $d = 0.98$), confirms that macro-level structural scaffolding can exert a substantial influence on micro-level grammatical performance.

Importantly, the improvement was not evenly distributed across all error categories. The most pronounced reductions occurred in run-on sentences (37.89%) and comma splices (51.75%)—the very error types identified at baseline as the most frequent and strongly associated with L1 rhetorical transfer. This pattern suggests that explicit macro-structural instruction can function as a structural regulator of sentence boundaries. By providing learners with a rigid, predictable rhetorical blueprint, ESIS appears to have constrained clause expansion and reduced the tendency to reproduce Arabic-style coordinate linkage in English writing.

From a theoretical perspective, these findings offer empirical support for Cognitive Load Theory as a productive explanatory framework. The structured essay blueprint likely reduced extraneous cognitive load associated with idea generation and organization,

thereby freeing working memory resources for grammatical monitoring and boundary control. The large effect size further suggests that the instructional impact was not merely statistical but cognitively substantive.

The results also extend contrastive rhetoric research by demonstrating that L1-influenced error patterns—particularly those related to clause linkage—are not resistant to change. Rather than attempting to suppress L1 influence through isolated grammar drills, the intervention addressed rhetorical organization directly, enabling learners to consciously regulate transfer tendencies. Qualitative findings reinforce this interpretation: participants reported increased awareness of L1/L2 contrasts and described the structure as a mechanism for interrupting habitual boundary errors.

Pedagogically, the findings challenge approaches that treat grammar instruction and essay organization as separate domains. The substantial decline in boundary errors suggests that structural awareness can indirectly strengthen grammatical control when embedded within purposeful genre tasks. However, the comparatively smaller reductions in modifier placement and phrasal preposition errors indicate that not all linguistic subsystems respond equally to macro-structural scaffolding. Some micro-level forms may require targeted, form-focused instruction alongside structural guidance.

At the curriculum and teacher education levels, the study supports an integrated instructional model in which macro-level rhetorical structure and micro-level sentence accuracy are developed concurrently. Writing pedagogy for Arabic-speaking EFL learners may benefit from explicit essay blueprints that simultaneously serve as cognitive scaffolds, contrastive tools, and self-monitoring frameworks (Hyland, 2007).

Conclusion

Overall, the findings underscore that improvements in sentence-level accuracy emerge most effectively within instructional environments that align cognitive load management, rhetorical organization, and grammatical awareness. Rather than viewing sentence accuracy as a purely rule-based phenomenon, the results indicate that structural clarity at the discourse level can meaningfully reshape learners' control over sentence boundaries and grammatical precision. To conclude, this study examined the impact of explicit persuasive essay structure instruction on sentence-level errors among Arabic-speaking EFL learners. The findings revealed a statistically significant improvement in sentence-level accuracy following the ESIS intervention, including a 34.79% overall reduction in structural errors and a significant gain in writing scores ($t(59) = 8.01$, $p < 0.001$, $d = 0.98$).

The most substantial improvements occurred in sentence-boundary errors, particularly run-on sentences and comma splices, suggesting that macro-level structural guidance can enhance micro-level grammatical control. These results support the integration of essay structure instruction into EFL writing pedagogy as a means of improving both organizational clarity and sentence accuracy.

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Effectiveness of Meaning-Based Grammar Instruction in ESP: A Moderated Model of Motivation and Learning Preferences in Accounting Education

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Abstract

Grammar instruction in English for Specific Purpose (ESP) has traditionally emphasized structural accuracy, often overlooking motivational and learner-difference factors that may influence learning outcomes. However, contemporary applied linguistics increasingly argues that instructional effectiveness operates through complex interactions among pedagogical design, affective variables, and learners' characteristics. This study addresses the question of whether meaning-oriented grammar instruction improves English achievement directly or indirectly through motivation, and whether perceptual learning style conditions this relationship. This study examines the effectiveness of Meaning-Based Approach to Pedagogical Grammar (MAP Grammar) and tests whether motivation mediates its effect on achievement and whether perceptual learning styles moderate these direct and indirect relationships. A quasi-experimental design was implemented over one semester involving 50 undergraduate accounting students divided into a MAP Grammar group (n = 25) and a conventional group (n = 25). Data were collected through pre-and post-test of English achievement, a validated motivation questionnaire, and a perceptual learning style inventory administered at the end of the intervention. Data were analyzed using independent-samples t-test and regression-based conditional process analysis (PROCESS Model 59) with 5,000 bootstrap resampling. The results showed that MAP Grammar significantly improved English achievement, $t(48) = 3.38$, $p = .001$. Although learning materials significantly predicted motivation ($p < .001$), motivation did not significantly predict achievement after controlling for instructional variables and the indirect effect was not significant. Perceptual learning style also did not moderate any effects. These findings suggest that MAP Grammar improved achievement primarily through direct instructional mechanism, rather than through motivational pathways or learning style fit.

Keywords: Accounting Students, ESP, English Achievement, Learning Style, MAP Grammar

Introduction

The globalization of higher education, coupled with the convergence of international accounting standards, has increased the demand for graduates who not only possess field-specific knowledge but also strong English communication skills. This is particularly in crucial in the field of accounting, where English serves as the primary language for financial documentation, audit processes, text practices, and international business

communication (Aburous & Kamla, 2022). In this context, English for Specific Purpose (ESP) provides a theory-based and research-supported framework that focuses on the analysis of target situations and discourse related to the discipline, thereby ensuring ensuring that language instruction allign with the learners' academic and professional needs (Hutchinson & Waters, 1987; Dudley-Evans & St. John, 1998).

Review of Related Literature

Accordingly, accounting graduates are expected to demonstrate grammatical accuracy, genre awareness, and the ability to compose accurate and context-sensitive professional texts. However, even though ESP has a strong theoretical foundation, grammar teaching in many higher education contexts is still dominated by a rule-based approach that is detached from context, thereby limiting students' ability to transfer grammatical knowledge into authentic professional communication. Recent research in applied linguistic encourage the re contextualization of grammar as a resource of meaning formation, rather than merely a prescriptive system, emphasizing the dynamic integration of form, meaning, and use (Larsen-Freeman & Anderson, 2011). From a cognitive and usage-based perspective, grammar learning becomes more effective when integrated into meaningful disciplinary discourse, as language patterns develop through repeated exposure and functional use (Navarro & Lallier, 2025).

The Meaning-Based Approach to Pedagogical Grammar (MAP Grammar) operationalizes this integration by systematically linking structural sequencing with communicative function and professional context (Tajino, 2019). Although meaning-based grammar instruction has gained theoretical support, empirical validation within this discipline-specific higher education, particularly accounting programs, remains limited. This gap raises an important question; Does meaning-based grammar instruction, in this case MAP Grammar, directly enhance achievement, or does its effectiveness operate through-learner related mechanism?

Learner variable, particularly perceptual learning style and motivation, are often used to explain differences in learning outcomes. However, the learning style matching hypothesis has been widely criticized for its lack of strong empirical support (Brown, 2023). Contemporary research increasingly treats learning styles as learner preferences that may interact with instructional conditions rather than deterministic predictors of performance. In contrast, Dörnyei's L2 motivational self-system and subsequent developments highlight the dynamic relationship between learner's future self-guides, contextual experiences, and academic engagement. In ESP contexts, particularly professional such as accounting, instrumental and career-oriented motivations may play a decisive role in shaping learning outcomes (Yang & Wyatt, 2021).

Theoretically, meaning-based instructional design is believed to increase motivation by enhancing perceptions of relevance, task value, and professional authenticity (Ryan & Deci, 2000). Empirical research shows that learning effectiveness often works indirectly through motivational engagement, rather than learning effectiveness often works indirectly through motivational engagement, rather than, solely through direct instructional exposure (Syring et al., 2015). However, there is still little research that integrates learning design, perceptual preferences, and L2 motivation into a single integrated empirical model, especially in the context of ESP grammar teaching.

To address this gap, this study advances the field of study in three aspects. First, theoretically, this study integrates cognitive grammar, ESP pedagogy, debates on learning style, and contemporary L2 motivation theory into a moderated mediation framework. Rather assuming a direct instructional influence, this study conceptualizes motivation as a mediating and learning style as a potential moderator. Second, methodologically, this study goes beyond simple group comparisons by applying reliability and validity testing, interaction analysis, mediation tests to align statistical modeling with theoretical assumption, this approach responds to recent calls for stronger conceptual-statistical coherence in applied linguistic research. Third, practically, this study provides evidence-based guidance for ESP teaching focused on accounting, clarifying whether grammar teaching innovations should prioritize learning style matching or motivational engagement in curriculum design.

Research Questions

Accordingly, the study addresses the following research questions: 1) To what extent does instructional material (MAP Grammar vs. conventional instruction) affect accounting students' English learning achievement? 2) What are the dominant perceptual learning styles of accounting students in learning English? 3) Is there a significant difference in English learning achievement among students with different perceptual learning style? 4) Is there an interaction effect between instructional material and perceptual learning style on students' English learning achievement? By placing grammar teaching within a framework mediated by motivation and sensitive to interaction, this study aims to provide explanation of the effectiveness of learning that is strongly grounded in theory and supported by solid empirical evidence in the context of ESP focused on the field of accounting.

Methodology

This study employs a quasi-experimemtal design integrated with conditional process analysis to examine the direct and indirect effects, as well as the moderating effects, of lerning approaches on students' English learning outcomes. Two learning instructions, namely MAP Grammar nad conventional grammar instruction were compared to determine their effectiveness in improving students' achievement. Within this framework, motivation was positioned as a mediating variable, while perceptual learning style served as as a moderating variabel, thereby enabling a more in-depth analysis of how learning effects vary based on learner caharacteristics. The study participants were 50 undergraduates accounting students enrolled in a English for Specifc Purpose (ESP) course at a private university in Indonesia, divided into two groups as an experimental group and a control group, each consisteing of 25 students. A priori power analysis using G'Power 3.1 indicated that the sample size was adequate to detect a moderate effect.

Data were collected using theree validated instruments, namely the Perceptual Learning Style Questionnaire ($\alpha = 0.84$), the Motivation Scale ($\alpha = 0.91$; CFI = 0.93; RMSEA = 0.06), and an ESP-based English Proficiency Test covering grammar, vocabulary, reading, listening, and writing (KR-21 = 0.42). the study was conducted over one semester, beginning with a pre0test, followed by a 12-week learning intervention, and concluding with a post-test, with motivation measured at the end of the intervention. Data analysis was performed using SPSS 26 and the PROCESS macro, which included tests of initial assumptions, mediation analysis using the bootstrapping technique (5,000) samples, and moderation analysis through interaction effects. The final model was able

to explain 56% of the variance in students' achievement ($R^2 = 0.56$), indicating a strong explanatory power.

Analysis

Several steps had been taken to classify the English learning achievement of accounting students in learning English and identify their learning styles. The findings can be explained as follows.

Descriptive Statistics of instructional material, learning style, and learning achievement

Before examining differences and interaction effects, descriptive statistics were calculated to summarize the distribution of instructional materials, learning styles, and English learning outcomes. The analysis revealed varying levels of data distribution for each studied variable as can be noticed from the following table:

Table 1. Descriptive statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Material	50	1	2	1,50	,505
learning style	50	1	4	2,00	,833
Learning achievement	50	60	97	73,78	7,786
Valid N (listwise)	50				

Based on table 1, the instructional materials variable showed a low standard deviation (SD = 0.505), indicating that the study participants were relatively evenly distributed between the groups using MAP Grammar and the conventional instructional materials. This balanced distribution strengthens the internal validity of the quasi-experimental design by ensuring that comparisons between learning groups were not influenced by an imbalance in the number of subjects.

The learning styles variable showed a moderate level of variation (SD = 0.833), indicating that students' perceptual learning style preferences were quite diverse but not extreme. This distribution supports the use of a factorial design and allows for testing of meaningful interaction effects between instructional materials and learning styles. Conversely, English learning outcomes showed a higher standard deviation (SD = 7.786), reflecting significant differences in student performance levels. This variation confirms the existence of low- and high-achieving students and provides strong justification for further inferential analysis, specifically a two-way ANOVA, to examine the influence of instructional materials and learning styles on learning outcomes.

Accounting students' learning style in English

This section presents the findings related to accounting students' learning preferences in English learning. Table 2 summarizes the dominant learning preferences observed in each instructional group.

Table 2. Learning preferences of students

Instructional Material	Learning Style Preference	Score	Learning Preference Category
Conventional	Auditory	50	Major
MAP Grammar	Group-based	50	Major

Based on Table 2, it can be observed that students with auditory learning preference as their primary style used conventional instructional materials, and students with a group-based learning preference used MAP Grammar materials, both scored 50. This indicates that there was no significant advantage of one type of instructional material over another in relation to a specific learning style.

Accounting Students' Learning Achievement in English and the Difference with the Type of Instructional Material

Answering question number 3, based on the data obtained, the English learning achievement of accounting students shows a clear difference between the low achiever group and the high achiever group based on the type of instructional material used as in the following table:

Table 3. Distribution of accounting students' English learning achievement by achievement group and instructional material

Achievement Group	Instructional Material	N (Students)	Score range
Low Achievers (<75)	Conventional	15	63 – 73
High Achievers (>75)	Conventional	12	71 – 81
High Achievers (>75)	MAP Grammar	22	75 – 97

Based on Table 3, students with low achievement who used conventional materials scored between 63 and 73. The score distribution of students who used conventional materials tends to be narrower and more stagnant. On the other hand, the high achiever group shows a more significant improvement, especially among those who used MAP Grammar materials. Students in this group who used conventional materials scored between 71 and 81, while those who used MAP Grammar scored between 75 and 97.

Additionally, statistical analysis shows a significant difference in English learning achievement between students taught using MAP Grammar instructional materials and those taught using conventional materials. In the first hypothesis test, the p-value was 0.00, which is lower than the significance level of 0.05. This indicates that the type of instructional material has a significant effect on the English learning achievement of accounting students.

The table shows that among the 15 students categorized as low achievers (students who scored below 75), 13 of them were from the conventional group, and only 2 students were from the MAP Grammar group. This indicates that most students taught with MAP Grammar were not in the low achiever category. On the other hand, among the 34 high achievers (students who scored 75 or above), 22 students were from the MAP Grammar group, while the remaining 12 students were from the conventional group. This shows a clear difference that students taught with MAP Grammar materials tend to achieve higher

scores, while those taught with conventional materials are more likely to remain in the low achiever category.

The difference in students' learning achievement in English with their learning style
In addition, based on the calculation results, the obtained p-value was 0.378, which is greater than the significance level of 0.05. This indicates that the answer for the fourth question shows no statistically significant difference in English learning achievement levels (low or high) among accounting students based on their learning styles. The differences in learning outcomes across visual, auditory, group-based, and individual learning styles are not statistically meaningful. Although there were slight variations in the mean scores among different learning styles, these differences were not significant enough to conclude that one learning style consistently outperformed the others.

The interaction effect between the type of instructional material and learning style on accounting students' learning achievement in English

For the fourth question, the results obtained from the two-way ANOVA showed a significant interaction effect between instructional material and learning style on the English learning achievement of accounting students as can be seen from the following figure.

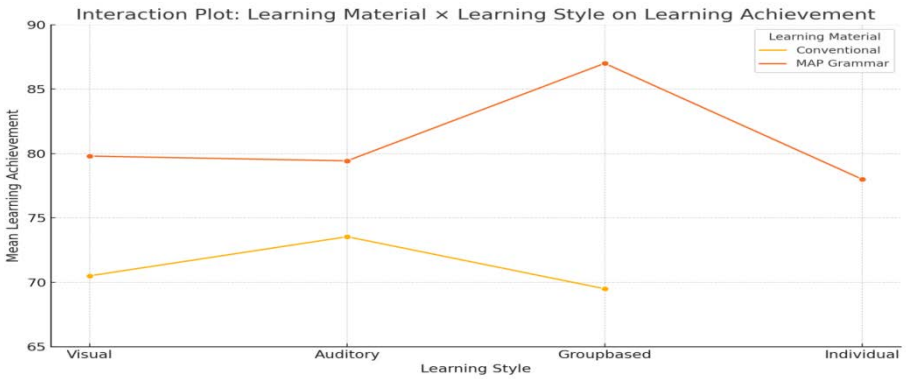

Figure 1: The interaction Effect between the Type of Instructional Material and Learning Style on Accounting Students' Learning Achievement

Although the two-way ANOVA indicated a significant interaction, this effect was not supported in the regression-based conditional process analysis, suggesting that the interaction may not be robust when controlling other variables. In addition, the p-value was 0.04, which is lower than the significance level of 0.05. Looking at the mean scores, this interaction becomes clearer in how certain learning styles perform better than others when paired with particular learning material This means that the English learning achievement of accounting students depends on the type of instructional material used, and vice versa.

Findings and Discussion

This present study set out to examine the extent to which instructional material and learning style influence accounting students' English learning achievement within an ESP context. The finding indicates the use of MAP Grammar materials is more effective than conventional materials in improving English learning achievement among accounting students. These findings are in line with recent studies which emphasize the effectiveness of meaning-based approaches in grammar instruction for both academic and professional

purposes. For example, a study by Özer & Şükrü Özba demonstrated that context- and meaning-based grammar instruction significantly improved English language skills among non-English major students, particularly in the context of English for Specific Purposes (ESP) (Özer & Şükrü Özbay, 2022). It highlighted the importance of cognitive approaches to grammar teaching that promote natural and conscious processing among learners. Meaning-based approach such as MAP Grammar (Ulyasari, 2025), which emphasizes word order and contextual meaning, also aligns with input-based communicative teaching models (Tajino, 2019). These studies reinforce that approaches like MAP Grammar are supported by strong theoretical and empirical foundations in the development of effective instructional materials.

The fact that different learning styles resulted in the same score across different instructional approaches highlights the complexity of evaluating the effectiveness of teaching materials. This finding is important because it emphasizes the need for flexible instructional design that can accommodate student diversity. This finding is in line with several recent studies that question the direct impact of learning styles on academic achievement. For example, research by Shaidullina et al., (2023) found that although learning styles influence classroom interaction preferences, they do not significantly affect academic performance unless combined with active engagement strategies. Another study also concluded that matching teaching methods with students' learning styles does not always lead to better learning outcomes (Cimermanová, 2018). Thus, instructional materials should be designed to encourage active learning, regardless of students' preferred styles, especially for those in accounting programs.

However, in the term of students' learning style that determines their learning achievement, could be simply caused by other factors such as students' learning engagement, background knowledge, even motivation as what has been found in answering the first research question. This finding also suggests that the type of instructional approach may play a more decisive role in influencing students' learning outcomes than learning style alone. This result is in line with the findings of El-Sabagh, who emphasized the importance of aligning instructional strategies with students' learning styles (El-Sabagh, 2021). The findings of this study show that learning style is not the only factor that contributes substantially to learning achievement. Instead, the results suggest that strengthening effective instructional design, such as the MAP Grammar approach used in this current study may have a positive impact on students with various learning preferences

This result is not coincidental, instead reflects the pedagogical foundation of the MAP Grammar approach. As proposed by Tajino (Tajino, 2017), MAP Grammar is based on three core principles: simultaneous stimulus and response, consistent practice, and meaningful interaction. These principles are implemented through a nine-step learning cycle that connects new knowledge with students' prior experience and guides them through practical application, supported by continuous feedback. These elements are highly effective in engaging learners, especially those with visual and group-based learning styles, who tend to thrive in structured and interactive learning environments.

Furthermore, MAP Grammar focuses on building sentences using a structured sequence, namely the agent (Who), action (Does), object (What), and context of time and place (Where/When). This sequence provides a scaffold and cognitively accessible pathway for learners to understand sentence construction and meaning within context (Gray &

Smithers, 2019). This structured method not only helps learners internalize English grammar more effectively but also supports the development of fluency and knowledge transfer into real communication, which is essential in English for Specific Purposes (ESP) settings such as accounting.

When students' learning styles are appropriately paired with the right instructional material such as MAP Grammar, the result is more consistent and higher academic achievement, as shown in the findings of this study. The alignment between learning preferences and instructional approach strengthens the impact of the learning process and maximizes student outcomes. The distribution of high and low student scores based on the type of learning material also provides additional evidence that MAP Grammar has a pedagogical impact on English learning, particularly for accounting majors. These findings indicate that students exhibited low English achievement when taught with conventional materials, while the majority of high-achieving students received instruction with MAP Grammar. This pattern indicates that conventional grammar instruction tends to limit learner development by emphasizing rule memorization and isolated practice, resulting in relatively stagnant learning outcomes. In contrast, MAP Grammar appears to support movement from low to high achievement by providing structured and meaningful grammatical input aligned with learners' communicative needs. From an ESP perspective, this shift is significant because it demonstrates that meaning-based grammar instruction not only improves overall learning achievement but also contributes to reducing the performance gap between learners at different levels of language proficiency.

Conclusion

This study concludes that MAP Grammar significantly improves the English proficiency of accounting students through direct learning mechanism. Motivation, although influenced by the learning material, does not act as a mediator of learning outcomes, and perceptual learning styles do not moderate learning effectiveness. These findings underscore the importance of cognitively structured and meaning-based learning designs in the ESP context and suggest that curriculum development should prioritize the quality of learning over adaptation to learning styles.

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An OBE Case Study on Redesigning College English Assessment in GCAST, Guangzhou, China

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Abstract

In China, traditional college English assessments tend to focus on knowledge input and summative exams but neglect students' practical language application skills, intercultural communication abilities, and developmental progress during the learning process. As higher education becomes increasingly internationalized and the need for cultivating applied talents grows, College English, as an indispensable component of general education, has drawn significant attention to the scientific validity and effectiveness of its teaching quality and evaluation system. Outcome-Based Education (OBE) is an educational model centered on learning outcomes, emphasizing that educational objectives should align directly with societal needs, professional competencies, and student development requirements. The OBE concept highly aligns with the talent cultivation goals of application-oriented universities and has begun to be carried out in China's application-oriented higher education institutions. This study adopts OBE as its core guiding principle, focusing on the reconstruction of the College English course evaluation system in Guangzhou University of Applied Science and Technology (GCAST). It explores how to establish a scientific, dynamic, and operational evaluation framework for College English teaching. This research not only integrates OBE principles into language assessment but also provides actionable pathways for College English teaching reform in application-oriented universities. Additionally, it can offer evidence-based insights for educational policymakers, curriculum designers, and frontline instructors. Preliminary implementation with 180 students showed improved performance on integrated tasks, though workload and scoring reliability challenges were identified.

Keywords: Assessment Framework, College English, GCAST, OBE

Introduction

Outcome-Based Education (OBE) originated from the work of William Spady in the 1980s and 1990s, who defined it as "a way of designing, developing, delivering, and documenting instruction in terms of its intended goals and outcomes" (Spady, 1994). The OBE framework is built on four fundamental principles: clarity of focus (all instructional activities center on what students should know and be able to do), expanded opportunity (providing students with multiple pathways and timeframes to demonstrate learning), high

expectations (requiring all students to achieve meaningful outcomes), and design down (designing the curriculum backward from final outcomes).

Research Background and Introduction to GCAST

Chinese higher education is undergoing a profound transformation. The Ministry of Education's "Implementation Plan for the Undergraduate Teaching Quality Assessment of Regular Institutions of Higher Education (2021-2025)" explicitly requires universities to fully implement three core concepts: "student-centered, outcome-oriented, and continuous improvement" – which are precisely the fundamental principles of Outcome-Based Education (OBE). This policy direction signifies not merely operational adjustments, but a fundamental paradigm shift from traditional input-oriented quality assurance to evidence-based demonstration of graduate competencies.

Review of Related Literature

Guangzhou College of Applied Science and Technology (GCAST), as a comprehensive application-oriented undergraduate institution in Guangdong Province, exemplifies this tension. The university's College English course serves approximately 8,000 students annually from diverse disciplinary backgrounds. Prior to the 2024 reform, the course's evaluation system exhibited traditional characteristics of language teaching: the final exam accounted for 70% of the total grade, assessment items focused on discrete grammatical knowledge and vocabulary recognition rather than communicative competence, and formative assessment, where it existed, consisted primarily of attendance records and homework completion logs. While student pass rates on internal assessments consistently exceeded 90%, they demonstrated significant competence deficiencies in authentic language application contexts. This disconnects prompted faculty and administrators to recognize the misalignment in the evaluation system.

The misalignment between GCAST's College English evaluation practices and intended learning outcomes can be described across three dimensions. First, at the curriculum articulation level, course learning objectives were neither derived from program-level graduate competency statements nor defined in measurable terms. Learning objectives such as "students will improve their English communication skills" failed to specify conditions of application, performance criteria, or specific contexts. Second, at the assessment design level, assessment tools measured what was easiest to measure, such as vocabulary recognition, discrete sentence-level grammatical accuracy, rather than what was most important like integrated communicative competence, strategic competence, intercultural reasoning. Third, at the feedback utilization level, assessment data were used primarily for summative grading purposes rather than to guide instructional adjustments or document course-level outcome attainment.

Objectives

This case study aims to answer the following questions:

(1) How can OBE principles be specifically applied to the reconstruction of the evaluation system for a College English course at an application-oriented undergraduate institution in China?

(2) What evidence regarding outcome attainment and instructional quality improvement can be obtained through the reconstructed evaluation system?

Methodology

Phase One: Defining Outcomes

The reconstruction process began with systematically defining learning outcomes – a task proved more challenging than initially anticipated. A working group consisting of six experienced faculty members, two curriculum specialists, and the department head spent three months developing outcome statements that met OBE criteria which mainly are specificity, measurability, and meaningfulness. The resulting outcome framework encompassed three domains with 3 targets respectively:

(1) Language Competence Domain. T1: Able to comprehend main ideas and detailed information in medium-length (800-1200 words) academic and professional texts, with a reading speed of 150 words per minute and 85% comprehension accuracy; T2: Able to produce 300-500 word coherent written texts that articulate clear arguments, develop reasoning with evidence, and employ appropriate syntax, grammar, and vocabulary according to purpose and audience; T3: Able to engage in sustained spoken interaction on familiar topics, including initiating and responding to questions, expressing and justifying opinions, and managing turn-taking, with minimal communication breakdown.

(2)Strategic Competence Domain. T1: Able to employ listening strategies (prediction, note-taking, inference) to comprehend authentic spoken materials; T2: Able to employ writing process strategies (planning, drafting, revising, editing) to enhance text quality; T3: Able to employ compensatory strategies (circumlocution, approximation, requesting clarification) to overcome communication breakdowns.

(3)Intercultural Competence Domain. T1: Able to identify cultural references and assumptions in English-language materials and explain their meanings; T2: Able to demonstrate culturally appropriate communicative behaviors in simulated intercultural situations; T3: Able to articulate similarities and differences between Chinese culture and target language cultures in terms of practices and values.

Phase Two: Assessment Design

Following outcome definition, the working group redesigned assessment tasks to elicit evidence of outcome attainment. The new framework shifted from a single final examination in the past to a "50/20/30" model: 50% formative assessment, 20% summative performance tasks, and 30% final closed-book examination. This weight distribution reflects OBE's emphasis on continuous evidence collection rather than one-time testing.

(1) Formative Assessment (50%). The formative assessment consists of 2 parts. The first part is weekly routine tasks (15%): Students complete weekly online quizzes targeting vocabulary and grammar knowledge. Unlike traditional quizzes, these provide immediate feedback and allow multiple attempts, with the highest score recorded. The purpose is diagnosis and learning promotion, not mere evaluation. The second part is performance tasks (35%): Three tasks per semester requiring integrated language production. Task one (required to finish from week 4 to 5) involves recording a 2-minute individual presentation on a course-related topic, submitted for peer and instructor feedback. Task two (from Week 8 to 10) is a collaborative group project producing a 5–7-minute podcast episode discussing an intercultural issue. Task three (from weeks 12 to 14) is an in-class debate requiring students to research, prepare,

and present arguments on a controversial topic. Each task incorporates structured peer evaluation and self-reflection components.

(2) Summative Performance Tasks (20%). Mid-term and end-of-term performance assessments require students to demonstrate integrated competence in scenarios simulating authentic communicative demands. The mid-term task is an integrated reading-writing task: students read two short texts presenting opposing viewpoints, then write a 400-word response synthesizing both texts and articulating their own position. The end-term task is a one-on-one oral interview with the instructor, including responses to impromptu follow-up questions.

(3) Final Closed-Book Examination (30%). The reduced-weight final examination focuses on outcomes not adequately covered by performance tasks, particularly long-text reading comprehension and discrete knowledge items. The examination includes 50 multiple-choice and short-answer questions (60% of exam score) and one extended writing task (40% of exam score).

Findings and Discussion

Evidence of Outcome Attainment

Analysis of student performance data (n=180) from the pilot course revealed outcome attainment patterns distinctly different from traditional final exam scores. While traditional final exam scores remained consistently high (M=82.4, SD=8.7), performance on the integrated writing task showed substantially greater variability (M=74.2, SD=12.3), with 23% of students scoring below the "meets expectations" threshold. This discrepancy is instructive. Students who performed well on discrete grammar and vocabulary items did not necessarily succeed in integrating these knowledge components in authentic writing tasks. Traditional assessment overestimated students' ability to apply knowledge – precisely the knowing-doing gap that OBE aims to address.

Instructor Perspectives

Instructor interviews revealed a mix of enthusiasm and implementation challenges. All six interviewed faculty members affirmed the pedagogical value of the new framework, with comments like: "I finally feel like I'm teaching for authentic communication, not just test-taking skills," and "Formative assessment lets me see students' thinking processes in a way that exams never could." However, instructors also reported significant increases in workload. Scoring performance tasks using analytic rubrics required 2-3 times more time duration than grading traditional exams. Providing meaningful feedback on diverse student submissions added additional hours. Several instructors noted that class sizes (still 55+ students) were incompatible with the individualized feedback envisioned by the new framework.

This case study documents the transformation of GCAST's College English evaluation system from an examination-centered model to an OBE-oriented, outcomes-driven system, encompassing outcome definition, assessment redesign, and rubric development with instructor calibration. Findings revealed both promise and challenges: students showed improved performance on integrated competence tasks and reported greater clarity about learning expectations. However, workload increases, anxiety about new assessment formats, and scoring reliability concerns emerged as significant barriers. Instructors

affirmed the pedagogical value of the new framework but reported substantial time demands requiring institutional support for sustainability.

Recommendations

For GCAST and similar institutions, the following recommendations are proposed:

(1) Maintain the "50/20/30" weight distribution while adjusting implementation to reduce workload, such as providing detailed feedback on sampled student submissions rather than individualized responses to every submission.

(2) Develop student orientation modules introducing OBE assessment expectations, including exemplary of varying quality levels and practice calibration activities.

(3) Establish a standing assessment committee with representatives from all course levels to continuously refine rubrics and coordinate assessment efforts across courses.

The GCAST case demonstrates that OBE assessment reconstruction is neither simple nor quick, but it is possible and worthwhile. The shift from *What did I teach?* to *What did students learn?* – and from measuring what is easiest to measure to measuring what is most important – represents precisely the kind of fundamental reform demanded by China's quality agenda. This case provides a roadmap for following researchers and institutions that have similar interest.

Conclusion

This case study documents the transformation of Guangzhou College of Applied Science and Technology's College English evaluation system from a traditional, examination-centered model to an OBE-oriented, outcomes-driven system. The reconstruction process involved three phases: defining measurable learning outcomes across language, strategic, and intercultural domains; designing corresponding performance assessment tasks; and developing analytic rubrics with instructor calibration. Implementation findings revealed both promise and challenges. Students demonstrated improved performance on integrated tasks measuring application competence; students reported greater clarity regarding learning expectations and valued feedback that supported improvement. However, workload concerns, anxiety regarding new assessment formats, and challenges regarding performance scoring reliability emerged as significant implementation barriers. Instructors affirmed the pedagogical value of the new framework but reported substantial time demands requiring institutional support for sustainability.

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Systematic Review of the Impact of Psychological Educational Interventions on Depression in the Era of Artificial Intelligence: Mechanisms, Applications, and Challenges

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Abstract

In the rapidly evolving era of artificial intelligence (AI), psychological educational interventions have emerged as a pivotal non-pharmacological approach for managing depression, undergoing significant paradigm shifts. This review systematically examines how AI technologies empower traditional psychological education interventions, focusing on their effects on treatment efficacy, accessibility, and personalization. We first outline the novel conceptual frameworks and theoretical underpinnings of psychological education interventions in the AI context. Subsequently, we analyze key technological applications, including machine learning and digital platforms, elucidate the mechanisms through which these AI-enhanced interventions influence depressive symptoms, and evaluate their implementation outcomes. Additionally, the review addresses ethical considerations and practical challenges encountered in deploying AI-driven psychological education, such as data privacy, algorithmic bias, and user engagement. By integrating the latest research findings, this article aims to provide a comprehensive theoretical foundation and practical guidance for the development of intelligent, personalized psychological educational interventions to improve depression care in the future.

Keywords: Artificial Intelligence, Depression, Digital Intervention, Machine Learning, Psychological Education, Personalized Treatment

Introduction

In the contemporary era marked by rapid advancements in artificial intelligence (AI), the landscape of mental health care, particularly for depression, is undergoing transformative changes. Depression remains a pervasive global public health challenge, characterized by high prevalence, significant morbidity, and substantial socioeconomic burden. Traditional psychological education interventions, such as cognitive behavioural therapy (CBT) modules, have long been established as effective approaches for managing depressive symptoms by imparting knowledge about the disorder's etiology, symptomatology, and coping strategies. However, these conventional methods often face critical limitations, including constrained accessibility due to resource scarcity, variability in treatment delivery, and challenges in maintaining long-term patient adherence. The integration of AI technologies into psychological education offers promising avenues to

address these shortcomings by enabling scalable, personalized, and continuous support systems that transcend the boundaries of traditional clinical settings (Ni, & Jia, 2025).

Review of Related Literature

AI-driven psychological education interventions leverage sophisticated computational techniques such as machine learning, natural language processing (NLP), and intelligent recommendation systems to dynamically tailor content and interaction based on individual user data. Unlike the fixed curricula and standardized delivery modes of traditional psychological education, AI-enabled systems can analyze real-time user inputs—including emotional states, cognitive patterns, and behavioral data—to adapt educational materials and therapeutic exercises responsively. This paradigm shift from a "one-size-fits-all" approach to a "precision education" model enhances engagement and efficacy by fostering interactive, user-centered learning experiences. For example, conversational agents powered by large language models (LLMs) can simulate therapeutic dialogues, facilitating thought recording and cognitive restructuring exercises integral to CBT, thereby accelerating cognitive correction processes and promoting self-awareness. Moreover, AI systems can provide 24/7 availability, offering immediate emotional support and behavioural activation prompts, which are crucial for timely intervention and relapse prevention.

Methodology

The theoretical underpinnings of AI-empowered psychological education interventions draw from established motivational and technology acceptance frameworks. Self-determination theory (SDT) emphasizes the importance of autonomy, competence, and relatedness in fostering intrinsic motivation, which AI systems can support by offering personalized choices, real-time feedback, and virtual companionship through AI assistants or community platforms. Concurrently, the Technology Acceptance Model (TAM) highlights perceived usefulness and ease of use as determinants of technology adoption; thus, AI interventions must demonstrate tangible benefits in symptom alleviation and maintain user-friendly interfaces to achieve widespread acceptance. Integrating these frameworks facilitates a comprehensive understanding of user engagement dynamics and informs the design of AI systems that not only deliver content effectively but also sustain long-term adherence and therapeutic alliance.

Analysis

Empirical evidence increasingly supports the feasibility and effectiveness of AI-based psychological education tools in depression management. Studies have demonstrated that AI conversational agents can successfully collect cognitive therapy data, such as thought records, and provide content-based feedback, although the motivational impact of feedback richness requires further exploration (Burger, Neerincx, & Brinkman, 2022). Randomized controlled trials indicate that dialog interventions with LLM-based AI agents significantly reduce depressive and anxiety symptoms among young adults, underscoring the potential of these technologies as adjunctive or alternative therapeutic modalities (Zhao, et all., 2025). Additionally, AI-powered chatbots have shown promise in enhancing user engagement and symptom tracking, with machine learning algorithms optimizing personalized content delivery and treatment pathways, resulting in improved clinical outcomes and reduced attrition rates (Ni, & Jia, 2025). These advances highlight the capacity of AI to transform psychological education from static knowledge dissemination into dynamic, interactive, and context-sensitive interventions.

Nevertheless, the rapid proliferation of AI applications in mental health education also raises critical ethical, practical, and technical challenges. Ensuring data privacy and security is paramount given the sensitive nature of psychological information collected by AI systems. Transparent and comprehensible informed consent processes are necessary to empower users with control over their data usage. Algorithmic biases stemming from non-representative training datasets may compromise fairness and equity, potentially exacerbating disparities in mental health care access and outcomes. Moreover, sustaining user engagement remains a persistent challenge, particularly among vulnerable populations affected by the digital divide, such as older adults or socioeconomically disadvantaged groups. Addressing these issues requires multidisciplinary collaboration to develop robust governance frameworks, equitable AI models, and user-centered designs that prioritize inclusivity and ethical integrity.

Findings and Discussion

In summary, the integration of AI into psychological education interventions for depression represents a paradigm shift with the potential to enhance accessibility, personalization, and effectiveness of mental health care. By harnessing advanced AI technologies, these interventions can provide continuous, adaptive support that aligns with individual needs and preferences, thereby overcoming many limitations of traditional approaches. However, realizing this potential necessitates rigorous research to elucidate underlying mechanisms, optimize application modalities, and navigate ethical and practical challenges. This systematic review aims to comprehensively synthesize current evidence on AI-enabled psychological education interventions in depression, elucidate their mechanisms of action, explore diverse applications, and critically examine the attendant challenges, thereby providing a roadmap for future research and clinical practice.

The integration of AI technologies into psychoeducational interventions for depression marks a transformative shift in mental health care, moving from traditional, standardized approaches to highly personalized, proactive, and real-time therapeutic strategies. From an expert perspective, this evolution is underpinned by the sophisticated application of machine learning, natural language processing, and digital platforms, which collectively enable nuanced cognitive restructuring, behavioural activation, and emotional regulation tailored to individual patient needs. The precision of ecological momentary interventions further enhances treatment efficacy by delivering support exactly when and where it is most needed, thereby improving accessibility and adherence in ways previously unattainable through conventional methods.

Balancing the promising benefits of AI-driven interventions with the inherent challenges requires a nuanced understanding of both technological capabilities and clinical realities. While AI offers unprecedented opportunities to augment therapeutic outcomes, it simultaneously raises critical ethical and practical concerns. Data privacy remains paramount, as sensitive patient information must be safeguarded against misuse or breaches. Algorithmic bias poses another significant hurdle, potentially perpetuating disparities if AI models are trained on unrepresentative datasets. Moreover, the digital divide threatens to exclude vulnerable populations from accessing these innovations, thereby exacerbating existing health inequities. Addressing these issues demands a collaborative approach involving developers, clinicians, and policymakers to establish

robust regulatory frameworks and ethical guidelines that ensure responsible AI deployment.

Conclusion

Future research directions should prioritize the development of AI models that are not only more accurate but also inherently fair, transparent, and secure. This entails rigorous validation across diverse populations to mitigate bias and enhance generalizability. Additionally, exploring synergistic models where AI tools complement rather than replace human therapists could optimize therapeutic alliances and outcomes. Such hybrid approaches may leverage the strengths of both AI's scalability and human empathy, fostering more holistic care. Importantly, efforts to bridge the digital divide must be integral to research and implementation strategies, ensuring equitable access to AI-enhanced psychoeducation for all individuals affected by depression, regardless of socioeconomic or geographic barriers. In conclusion, AI-driven psychoeducational interventions represent a paradigm shift with the potential to revolutionize depression treatment by enhancing personalization, immediacy, and engagement. However, realizing this potential fully and ethically requires a balanced integration of technological innovation with vigilant attention to privacy, fairness, and inclusivity. Through interdisciplinary collaboration and sustained commitment to ethical principles, the mental health field can harness AI's transformative power to deliver more effective, accessible, and equitable care for individuals living with depression

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Sensitive Medical Content and Emotional Alignment: Extending Constructive Alignment in Vocational English for Medical Purposes Education

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Abstract
The Constructive alignment has been widely adopted in higher education and English for Specific Purposes (ESP) contexts; however, its affective dimension remains underexplored, particularly in culturally sensitive instructional domains. In vocational English for Medical Purposes (EMP) education, topics related to reproductive health and gender-specific physiology are professionally essential yet emotionally sensitive for young learners. This study introduces the concept of emotional alignment as an extension of constructive alignment theory and empirically tests an Affective-Mediated Curriculum Alignment Model (AMCAM). Using survey and achievement data from 312 students in three Chinese vocational medical colleges, structural equation modeling was employed to examine the relationships among sensitive content exposure, emotional discomfort, classroom engagement, perceived professional relevance, and learning outcomes. Results indicate that emotional discomfort significantly reduces classroom engagement ($\beta = -.51$, $p < .001$), which mediates its impact on learning outcomes ($\beta = .57$, $p < .001$). Perceived professional relevance significantly moderates the relationship between emotional discomfort and engagement. Findings suggest that curriculum misalignment arises not from content irrelevance but from insufficient affective mediation. The study contributes theoretically by integrating emotional alignment into constructive alignment theory and offers pedagogical implications for ESP and medical education globally.

Keywords: Affective-Mediated Curriculum Alignment Model (AMCAM), Constructive Alignment, Emotional Alignment, English for Medical Purposes, Sensitive Content, Structural Equation Modelling, Vocational Education

Introduction

Constructive alignment (Biggs, 1996) has become a foundational framework in curriculum design across higher education. The theory posits that effective teaching requires alignment among intended learning outcomes, instructional activities, and assessment practices. In English for Specific Purposes (ESP), alignment additionally entails matching course content with learners' professional needs (Hutchinson & Waters, 1987).

However, alignment has traditionally been conceptualized in structural and cognitive terms, largely neglecting the affective dimension of learning. This omission becomes particularly salient in vocational English for Medical Purposes (EMP) classrooms, where students are required to engage with sensitive medical topics such as reproductive health, pregnancy complications, and gender-specific anatomy. Although professionally essential, these topics

often evoke embarrassment, avoidance behaviours, and emotional discomfort among young learners. In Chinese vocational medical colleges, instructors report observable affective reactions when teaching such units. Some teachers even omit or simplify reproductive health content, arguing that unmarried students lack relevant life experience.

Review of Related Literature

Recent scholarship has increasingly emphasized the multidimensional nature of curriculum alignment beyond structural coherence. For instance, Andrade (2020) argued that alignment frameworks must incorporate learner engagement variables to account for actual instructional effectiveness. Similarly, Villarroel et al. (2021) demonstrated that alignment quality predicts learning outcomes only when student engagement is considered.

In ESP contexts, Hyland (2019) highlighted the need for discipline-sensitive pedagogy that integrates sociocultural expectations. Song and Caruso (2021) further emphasized that vocational ESP learners demonstrate stronger occupational motivation but heightened classroom anxiety in culturally sensitive units.

In medical education research, O'Connor et al. (2020) found that early exposure to reproductive health content can trigger emotional discomfort, potentially affecting knowledge retention. Likewise, Wear et al. (2021) noted that discomfort does not necessarily imply irrelevance but requires pedagogical framing.

Recent studies on affective variables in language learning have expanded beyond anxiety. Li (2020) identified embarrassment as a distinct predictor of reduced participation in EFL classrooms. Jiang and Dewaele (2022) demonstrated that culturally sensitive topics intensify emotional filtering effects in Asian contexts.

Moreover, structural equation modeling has increasingly been used to examine mediated and moderated relationships in educational settings (Kline, 2023). For example, Wang and Zhang (2022) found that professional identity moderates anxiety-performance relationships in vocational learners.

Taken together, recent research suggests: Alignment must include affective dimensions. Professional relevance can buffer emotional discomfort. Engagement mediates emotional impact on achievement.

However, no prior study has empirically integrated these elements within a constructive alignment framework in vocational EMP contexts. This study addresses that gap.

Research Questions

These practices raise a critical theoretical question: Can curriculum be considered aligned if it satisfies professional objectives but fails to align with learners' emotional readiness?

This study addresses this gap by proposing emotional alignment as a necessary extension of constructive alignment. Using empirical data from vocational EMP classrooms, the study investigates how emotional responses mediate curriculum effectiveness and whether perceived professional relevance mitigates affective misalignment.

Methodology

This study is grounded in constructive alignment theory (Biggs, 1996, 2003), which posits that effective teaching occurs when intended learning outcomes, instructional activities, and assessment practices are coherently aligned. While alignment theory has traditionally emphasized cognitive and structural coherence, recent scholarship suggests that alignment must also account for learner-level processes that influence how instruction is received and enacted. In contexts involving culturally sensitive medical content, such as reproductive health topics in vocational EMP classrooms, affective reactions may interfere with this alignment mechanism. When instructional content triggers embarrassment, anxiety, or avoidance tendencies, the alignment between curriculum design and learner engagement may be disrupted, thereby undermining learning effectiveness.

Drawing on affective filter theory (Krashen, 1985) and control-value theory of achievement emotions (Pekrun, 2006), emotional discomfort is conceptualized as a multidimensional affective construct encompassing embarrassment, anxiety, avoidance behavior, and cognitive distraction. These emotional responses are expected to function as mediating mechanisms that translate content exposure into variations in classroom engagement and subsequent learning outcomes. Specifically, exposure to sensitive medical content may heighten emotional discomfort, which in turn reduces behavioral, cognitive, and emotional engagement in classroom activities. Reduced engagement then weakens opportunities for meaningful interaction, knowledge construction, and performance achievement. Thus, classroom engagement is hypothesized to serve as a key explanatory pathway linking emotional discomfort to learning outcomes.

At the same time, vocational education contexts are characterized by strong occupational orientation. According to expectancy-value theory (Eccles & Wigfield, 2002), learners' perceptions of task utility influence motivational regulation and persistence. In medical vocational programs, perceived professional relevance may therefore buffer the negative impact of emotional discomfort. When students cognitively recognize the occupational necessity of mastering sensitive medical terminology, the detrimental effects of embarrassment or anxiety may be attenuated. Professional relevance thus operates as a moderating variable that conditions the strength of the relationship between emotional discomfort and engagement.

Integrating these theoretical perspectives, the present study proposes an Affective-Mediated Curriculum Alignment Model （see figure 1） in which sensitive content exposure increases emotional discomfort; emotional discomfort reduces classroom engagement; engagement enhances learning outcomes; and perceived professional relevance mitigates the negative influence of discomfort on engagement. This framework extends constructive alignment theory by incorporating affective and motivational mechanisms as integral components of curriculum effectiveness in culturally sensitive instructional contexts.

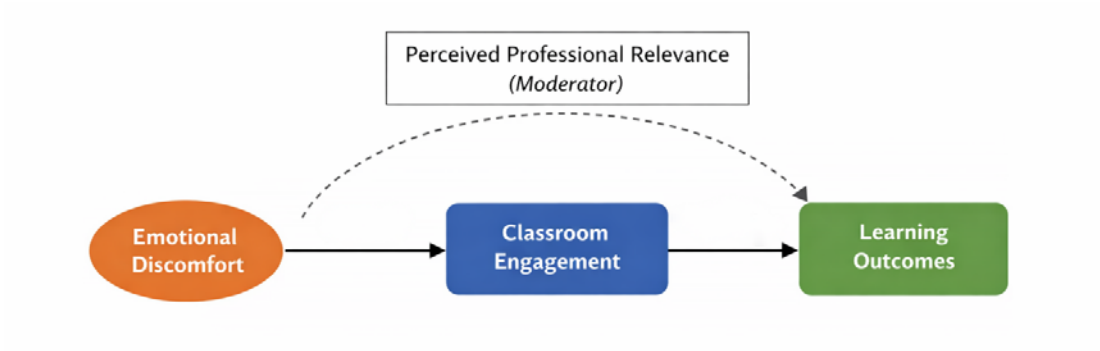

Figure 1. Affective-Mediated Curriculum Alignment Model (AMCAM). *Emotional discomfort negatively predicts engagement, which predicts learning outcomes; professional relevance moderates the path from emotional discomfort to engagement.*

Participants and Context

Participants were 312 second-year students recruited from three public vocational medical colleges in China. The sample consisted of 58% nursing majors and 42% clinical medicine majors, reflecting the typical disciplinary distribution within vocational medical programs. Female students accounted for 68% of the sample, consistent with gender patterns commonly observed in nursing-dominated cohorts. All participants had recently completed a compulsory English for Medical Purposes (EMP) instructional unit focusing on reproductive health terminology, including pregnancy-related syndromes and gender-specific clinical conditions. The instructional unit formed part of the standard EMP curriculum and was delivered over a four-week period prior to data collection.

Instruments

Emotional discomfort was assessed using an eight-item scale designed to capture four affective dimensions: embarrassment, avoidance behavior, anxiety, and cognitive distraction. Items were rated on a five-point Likert scale (1 = strongly disagree to 5 = strongly agree). The scale demonstrated excellent internal consistency reliability in the present study (Cronbach's $\alpha = .92$).

Classroom engagement was measured using a six-item scale assessing behavioral, emotional, and cognitive participation in EMP instruction. The instrument yielded satisfactory reliability ($\alpha = .88$), indicating stable internal consistency across engagement dimensions.

Perceived professional relevance was assessed with a four-item scale measuring the extent to which students perceived reproductive health terminology as occupationally necessary for their future medical practice. Internal consistency reliability was acceptable ($\alpha = .86$).
Learning outcomes were measured using a 30-item multiple-choice vocabulary achievement test specifically developed to assess mastery of reproductive health terminology covered in the instructional unit. The test included clinically relevant lexical items and contextualized usage questions. Internal consistency reliability, estimated using the Kuder–Richardson Formula 20 (KR-20), was .84, indicating satisfactory reliability for dichotomously scored items.

Procedure

Data collection was conducted immediately following completion of the instructional unit to ensure that emotional responses and engagement perceptions reflected authentic classroom experiences. Participation was voluntary and anonymous, and students were informed that their responses would be used solely for research purposes. No course credit or academic incentives were provided. Ethical procedures adhered to institutional research guidelines, and informed consent was obtained from all participants prior to survey administration.

Data Analysis

Data analysis proceeded in several stages. First, confirmatory factor analysis (CFA) was conducted to examine the adequacy of the measurement model and to assess construct validity. Reliability was evaluated using Cronbach's alpha and composite reliability indices, while convergent and discriminant validity were assessed using average variance extracted (AVE) and the heterotrait–monotrait ratio (HTMT).

Second, structural equation modeling (SEM) was employed to test the hypothesized relationships among sensitive content exposure, emotional discomfort, classroom engagement, professional relevance, and learning outcomes. Model fit was evaluated using multiple indices, including χ^2/df, CFI, TLI, RMSEA, and SRMR.

Finally, moderated mediation effects were examined using bootstrapping procedures with 5,000 resamples to estimate indirect effects and corresponding 95% confidence intervals. A mediation effect was considered significant if the confidence interval did not include zero.

Analysis

Preliminary Analyses

Descriptive statistics and bivariate correlations among the study variables are presented in Table 1. Sensitive content exposure was moderately and positively correlated with emotional discomfort ($r = .47$, $p < .001$), indicating that greater exposure to sensitive medical topics was associated with higher levels of discomfort. Emotional discomfort was negatively correlated with classroom engagement ($r = -.51$, $p < .001$) and learning outcomes ($r = -.38$, $p < .001$), suggesting that affective reactions may undermine both participation and achievement.

Table 1. Descriptive Statistics and Correlations Among Study Variables (N = 312)

Variable	M	SD	1	2	3	4	5
1. Sensitive Content	3.68	0.71	—				
2. Emotional Discomfort	3.42	0.83	.47***	—			
3. Engagement	3.51	0.76	−.28***	−.51***	—		
4. Professional Relevance	4.02	0.64	.22**	−.18*	.36***	—	
5. Learning Outcome	78.34	8.92	−.19*	−.38***	.57***	.29***	—

. $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Classroom engagement demonstrated a strong positive association with learning outcomes ($r = 0.57$, $p < 0.001$), supporting its hypothesized mediating role. Perceived professional relevance was positively correlated with engagement ($r = .36$, $p < .001$) and learning outcomes ($r = .29$, $p < .001$), while showing a modest negative association with emotional discomfort ($r = -.18$, $p < .05$). None of the intercorrelations exceeded .70, indicating that multicollinearity was not a concern.

Measurement Model

Confirmatory factor analysis was conducted to evaluate the adequacy of the measurement model (Table 2). The model demonstrated acceptable fit to the data: $\chi^2/df = 2.31$, CFI = .94, TLI = .92, RMSEA = .065, and SRMR = .054. These indices meet recommended thresholds for structural equation modeling (e.g., CFI and TLI > .90; RMSEA < .08).

Table 2. Confirmatory Factor Analysis Results

Construct	CR	AVE	Factor Loadings Range
Emotional Discomfort	.91	.63	.68–.84
Engagement	.88	.59	.65–.82
Professional Relevance	.86	.61	.70–.81

Model Fit:
$\chi^2/df = 2.31$
CFI = 0.94
TLI = 0.92
RMSEA = 0.065
SRMR = 0.054

All standardized factor loadings were statistically significant and ranged from .65 to .84, exceeding minimum recommended levels. Composite reliability (CR) values ranged from .86 to .91, indicating strong internal consistency. Average variance extracted (AVE) values were all above .50, supporting convergent validity. Discriminant validity was confirmed using the HTMT criterion (< .85). Collectively, these findings suggest that the constructs demonstrate satisfactory reliability and validity, justifying subsequent structural model testing.

Structural Model Results

Structural equation modeling was performed to test the hypothesized relationships (Table 3). Sensitive content exposure significantly predicted emotional discomfort ($\beta = .47$, $p < .001$), supporting Hypothesis 1. Emotional discomfort negatively predicted classroom engagement ($\beta = -.51$, $p < .001$), supporting Hypothesis 2. In turn, classroom engagement positively predicted learning outcomes ($\beta = .57$, $p < .001$), supporting Hypothesis 3. Emotional discomfort also exerted a direct negative effect on learning outcomes ($\beta = -.22$, $p = .004$), supporting Hypothesis 4 and suggesting partial mediation. The interaction term between emotional discomfort and perceived professional relevance significantly predicted classroom engagement ($\beta = .21$, $p = .006$), indicating that professional relevance moderated the relationship between discomfort and engagement (see figure 1) . Specifically, when professional relevance was perceived as high, the negative impact of emotional discomfort on engagement was attenuated.

The structural model accounted for 42% of the variance in learning outcomes ($R^2 = .42$), indicating substantial explanatory power within the vocational EMP context.

Table 3. Structural Model Path Coefficients

Path	β	SE	p
Sensitive Content → Emotional Discomfort	.47	.05	<.001
Emotional Discomfort → Engagement	−.51	.06	<.001
Engagement → Learning Outcome	.57	.07	<.001
Emotional Discomfort → Learning Outcome	−.22	.08	.004
Interaction (ED × PPR → Engagement)	.21	.07	.006

R^2 (Learning Outcome) = .42

Structural equation modeling was conducted to test the hypothesized relationships (see Table 3). Figure 1 presents the path coefficients and illustrates the mediating role of classroom engagement as well as the moderating effect of perceived professional relevance.

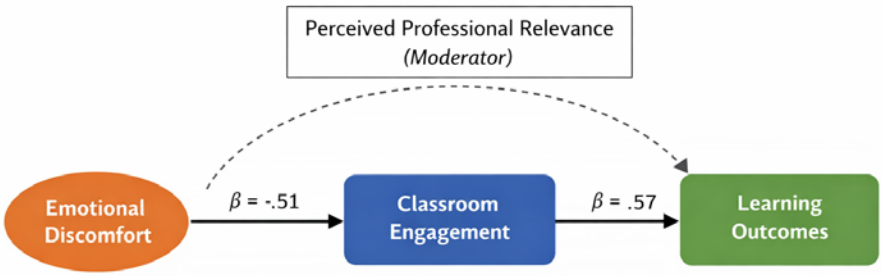

Figure 1. Affective-Mediated Curriculum Alignment Model (AMCAM). *Emotional discomfort negatively predicts engagement, which predicts learning outcomes; professional relevance moderates the path from emotional discomfort to engagement.*

Mediation Analysis

Bootstrapping procedures with 5,000 resamples were conducted to examine the mediating role of classroom engagement (Table 4). The indirect effect of emotional discomfort on learning outcomes via engagement was statistically significant (β = −.29), and the 95% confidence interval did not include zero [−.38, −.19]. This finding confirms that classroom engagement significantly mediates the relationship between emotional discomfort and learning outcomes.

Because the direct path from emotional discomfort to learning outcomes remained significant, the mediation can be interpreted as partial rather than full mediation. These results indicate that emotional discomfort undermines learning outcomes both directly and indirectly by reducing classroom engagement.

Table 4. Bootstrapping Mediation Analysis

Effect	Indirect Effect	95% CI	Result
ED → Engagement → LO	−.29	[−.38, −.19]	Significant

Summary of Findings

The combined findings from Tables 1–4 collectively substantiate the proposed Affective-Mediated Curriculum Alignment Model and provide a theoretically coherent explanation of how sensitive medical content influences learning outcomes in vocational EMP classrooms. The correlation patterns (see Table 1) offer preliminary evidence that emotional discomfort functions as a pivotal intervening construct linking sensitive content exposure to both diminished engagement and reduced academic performance. The strong association between classroom engagement and learning outcomes underscores the centrality of participatory processes in sustaining constructive alignment within specialized language instruction.

The confirmatory factor analysis results (see Table 2) further validate the distinctiveness and internal coherence of the latent constructs, supporting the conceptualization of emotional discomfort, engagement, and professional relevance as empirically separable yet theoretically interrelated dimensions. This measurement robustness provides a reliable foundation for examining structural relationships and reinforces the legitimacy of extending alignment theory to incorporate affective components.

The structural model findings (see Table 3) reveal that emotional discomfort operates as a critical affective mechanism that disrupts engagement processes, thereby weakening instructional effectiveness. Importantly, the moderating effect of professional relevance demonstrates that affective misalignment is not deterministic; rather, it can be mitigated when learners cognitively appraise sensitive content as professionally meaningful. This interaction effect suggests that alignment is not solely a matter of curricular coherence but also of perceived occupational value. Finally, the bootstrapped mediation analysis (see Table 4) confirms that classroom engagement serves as a significant explanatory pathway through which emotional discomfort influences learning outcomes. The significant indirect effect indicates that affective disruption undermines achievement primarily by reducing behavioral and cognitive participation. The persistence of a direct effect further suggests partial mediation, highlighting the multifaceted nature of affective influence in specialized language education.

Taken together, the results provide strong empirical support for the proposed Affective-Mediated Curriculum Alignment Model. Emotional discomfort emerges as a central affective mechanism linking sensitive content exposure to diminished engagement and academic performance, while perceived professional relevance functions as a buffering factor that mitigates this negative process.The results advance constructive alignment theory by empirically demonstrating that emotional alignment constitutes a necessary condition for effective curriculum implementation in culturally sensitive instructional contexts. The findings suggest that affective responses to sensitive medical content are not peripheral classroom phenomena but structurally embedded factors that shape engagement and achievement in vocational EMP education.

Findings and Discussion

The present study sought to examine how sensitive medical content influences learning outcomes in vocational EMP classrooms through effective and motivational mechanisms.

The findings provide robust empirical support for the proposed Affective-Mediated Curriculum Alignment Model and extend constructive alignment theory by demonstrating that emotional responses are not peripheral classroom reactions but structurally embedded components of instructional effectiveness. Specifically, exposure to sensitive reproductive health content significantly increased students' emotional discomfort, which in turn reduced classroom engagement and ultimately undermined vocabulary achievement. The results suggest that alignment in specialized language education cannot be conceptualized solely in cognitive or curricular terms; rather, it must also incorporate the affective experiences of learners.

Consistent with affective filter theory and control-value theory, emotional discomfort emerged as a pivotal mediating construct. Students who experienced embarrassment, anxiety, avoidance tendencies, and cognitive distraction were less behaviorally and cognitively engaged in classroom activities. This reduction in engagement significantly predicted lower academic performance, confirming that engagement functions as a key explanatory pathway linking emotion and achievement. Importantly, the mediation was partial rather than full, indicating that emotional discomfort exerts both direct and indirect influences on learning. This dual-path effect highlights the multifaceted role of affect in vocational language instruction and underscores the necessity of addressing emotional processes explicitly within curriculum implementation.

Another notable contribution of this study lies in identifying perceived professional relevance as a buffering mechanism. The moderating effect indicates that when students cognitively recognize the occupational necessity of mastering sensitive medical terminology, the negative impact of emotional discomfort on engagement is attenuated. In vocational medical contexts, professional identity and career orientation appear to provide motivational resources that counteract emotional inhibition. This finding aligns with expectancy-value theory and suggests that affective misalignment can be mitigated through enhanced perception of task utility. Thus, curriculum alignment in vocational settings involves not only coherence among objectives, instruction, and assessment, but also alignment between instructional content and students' emerging professional identities.

The findings also have important contextual implications. In many Asian educational contexts, discussions of reproductive health may be culturally sensitive, particularly among young adult learners without marital experience. The observed discomfort does not necessarily imply pedagogical inappropriateness; rather, it reflects the intersection of cultural norms and professional training demands. Avoiding such topics may create short-term emotional comfort but risks long-term professional inadequacy. Therefore, instructional design should aim to balance emotional sensitivity with professional authenticity. Strategies such as structured clinical framing, anonymized case-based discussion, and gradual terminology exposure may help reduce embarrassment while preserving curricular rigor.

Overall, this study advances theoretical and empirical understanding of how affective processes interact with curriculum alignment in specialized language education. By integrating emotional discomfort, engagement, and professional relevance into a unified explanatory framework, the research demonstrates that effective EMP instruction requires emotional alignment alongside cognitive and structural coherence. In culturally sensitive instructional contexts, acknowledging and strategically managing students' emotional responses is essential for sustaining engagement and optimizing learning outcomes.

Pedagogical Implications

The findings of this study carry important pedagogical implications for vocational EMP instruction, particularly in contexts where culturally sensitive medical content is unavoidable. First, curriculum alignment should be reconceptualized to include emotional alignment as a deliberate instructional objective. Teachers should anticipate potential emotional discomfort when introducing reproductive health or gender-related terminology and design instructional scaffolding accordingly. Rather than omitting sensitive units, educators can adopt structured clinical framing strategies that emphasize professional necessity and medical objectivity, thereby shifting students' focus from personal discomfort to occupational responsibility. Second, enhancing perceived professional relevance appears to be a viable intervention pathway. Explicitly linking sensitive terminology to real-world clinical scenarios, licensing requirements, or future workplace communication demands may buffer the negative effects of embarrassment and anxiety by activating students' professional identity. Third, classroom engagement should be actively cultivated through supportive participation formats, such as small-group discussions, case-based simulations, and anonymous response systems, which may reduce public performance pressure while maintaining interactional depth. Finally, teacher training programs in vocational medical education should include preparation for managing affective dynamics in specialized language classrooms. Developing instructors' sensitivity to emotional cues and equipping them with strategies for navigating culturally delicate topics can help sustain engagement without compromising curricular rigor. Taken together, these pedagogical implications suggest that effective EMP instruction requires not only linguistic expertise but also affect-informed instructional design that harmonizes professional authenticity with learners' emotional readiness.

Limitations and Future Research

Despite the theoretical and empirical contributions of this study, several limitations should be acknowledged, which also provide directions for future research. First, the cross-sectional design precludes causal inferences; while structural equation modeling allows for testing hypothesized relationships, longitudinal or experimental studies would be necessary to confirm the temporal dynamics of emotional discomfort, engagement, and learning outcomes. Second, the study relied exclusively on self-report measures for emotional discomfort, engagement, and perceived professional relevance, which may be subject to social desirability bias or common method variance. Future studies could incorporate behavioral observations, physiological indicators of emotional response, or teacher ratings to triangulate findings. Third, the sample was drawn from three vocational medical colleges in China, limiting generalizability across cultural or institutional contexts. Replication in diverse educational and linguistic settings would clarify the cross-cultural applicability of the Affective-Mediated Curriculum Alignment Model. Fourth, while the study focused on reproductive health terminology as a representative sensitive content unit, other sensitive medical domains—such as mental health, sexual health, or end-of-life care—may elicit different affective and engagement responses. Future research could examine the boundary conditions of emotional alignment across varied medical content areas. Finally, the moderation effect of perceived professional relevance was explored at the individual level; additional studies could investigate contextual or instructional factors, such as teacher scaffolding strategies or classroom climate, to determine how environmental variables interact with learners' affective responses. Addressing these limitations would strengthen the theoretical generalizability and practical utility of integrating emotional alignment into vocational EMP curriculum design.

Conclusion

This study provides both theoretical and practical insights into the role of emotional responses in vocational English for Medical Purposes (EMP) education, particularly in the context of culturally sensitive medical content. By introducing the concept of emotional alignment as an extension of constructive alignment theory, the research demonstrates that learners' affective experiences—encompassing embarrassment, anxiety, avoidance, and cognitive distraction—serve as critical mechanisms linking exposure to sensitive content with classroom engagement and learning outcomes. The findings highlight the mediating role of engagement and the moderating function of perceived professional relevance, suggesting that affective misalignment can be mitigated when students recognize the occupational utility of the content. Theoretically, this study advances curriculum alignment literature by integrating emotional and motivational dimensions into the traditionally cognitive-focused model, offering a more holistic framework for understanding how specialized language curricula impact learning in vocational contexts. From a practical standpoint, the results underscore the importance of designing EMP curricula that balance professional authenticity with students' emotional readiness. Educators are encouraged to implement scaffolding strategies, case-based discussions, and professional framing to reduce affective barriers while maintaining rigorous learning objectives. Additionally, teacher training should include sensitivity to learners' emotional responses, fostering classroom environments that support engagement even when content is culturally or personally challenging.

Finally, the study identifies avenues for future research, including longitudinal and experimental designs to establish causal relationships, exploration of diverse sensitive content areas, and examination of contextual or instructional factors that interact with learners' affective responses. By addressing these directions, future studies can further refine the theoretical and practical applicability of emotional alignment, ultimately enhancing the effectiveness of vocational EMP instruction across varied educational and cultural settings.

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Exploring the Factors Affecting Teachers' Capacity to Educate Students with Learning Difficulties

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Abstract

Educating children with learning difficulties requires high professional competence, including specialized pedagogical skills and strong institutional support. Aim: The aim of this study is to identify the factors affect teachers' efficiency in educating children with learning difficulties in Saudi Arabia. Methods: A quantitative cross-sectional correlational study was conducted among teachers working in public schools that provide services for students with learning difficulties. Data was collected using a structured questionnaire A stratified random sampling technique was used to select 390 teachers from schools' crosswise major regions of the Kingdom. Descriptive and inferential statistical analyses were applied to explore associations between teacher-related variables and their reported efficiency levels. Results: The findings showed moderate teacher efficiency in educating students with learning difficulties. Higher efficiency was associated with specialized training, tailored teaching materials, and strong administrative support. Major barriers included limited professional development, overcrowded classrooms, and inadequate resources, while collaborative teaching practices and positive attitudes toward inclusion enhanced teachers' effectiveness in inclusive educational settings. Conclusion: Teachers in Saudi Arabia are committed to supporting children with learning difficulties. However, improving teacher efficiency requires continuous specialized training, adequate educational resources, and strong institutional support to strengthen inclusive education and create more supportive learning environments across the Kingdom. Recommendations: School leaders should strengthen professional development, mentorship, and early-career training while ensuring fair resource distribution and supportive educational strategies to improve inclusive education and enhance teachers' ability to support students with learning difficulties.

Keywords: Efficiency, Learning Difficulties, Special Education, Teachers

Introduction

Education is widely recognized as a cornerstone of societal development, playing a critical role in shaping individuals' cognitive, social, and economic potential. Its effectiveness becomes even more significant when addressing the needs of children with learning difficulties, who require specialized instructional approaches and supportive learning environments. In Saudi Arabia, increasing attention has been directed toward inclusive education as part of national reforms aligned with Vision 2030. These efforts emphasize equal access to quality education for all learners, including those with diverse learning needs. The growing number of students enrolled in special education programs reflects this commitment, with reports indicating that thousands of learners across the Kingdom receive specialized educational services (Rana et al., 2019).

Learning difficulties are defined as disorders in one or more of the basic psychological processes involved in understanding or using language, whether spoken or written. These difficulties can affect essential academic skills such as reading, writing, listening, thinking, and communication. Conditions such as dyslexia, perceptual disabilities, developmental aphasia, and minor brain dysfunction fall within this category (Aldabas, 2020; Alnahdi & Schwab, 2021). It is important to note that learning difficulties are distinct from disabilities caused primarily by sensory impairments, intellectual disabilities, or environmental factors. Consequently, children with learning difficulties often require tailored instructional strategies, individualized support plans, and highly competent teachers who can effectively address their unique educational needs.

Review of Related Literature

The evolution of special education in Saudi Arabia has undergone significant transformation over the past decades. Prior to the 1950s, formal educational services for children with disabilities were virtually nonexistent. The establishment of the Department of Special Learning in 1962 marked a turning point in the provision of specialized education, initially focusing on students with intellectual disabilities, visual impairments, and hearing impairments (Rana et al., 2019). Subsequent developments included the establishment of specialized institutions, such as the Intellectual Education Institute in 1972, which aimed to enhance communication, social behavior, and life skills among students with intellectual disabilities (Abed & Shackelford, 2020). Further progress was achieved through legislative and policy reforms. The recognition of learning disabilities as a distinct category in 1996 led to the expansion of specialized services within mainstream education. The introduction of the Disability Code in 2000 ensured the right of individuals with disabilities to access essential services, including free education, healthcare, and rehabilitation. This was followed by the implementation of the Regulations of Special Education Programs and Institutes (RSEPI) in 2001, which mandated the provision of individualized education programs (IEPs) and appropriate support services for students with disabilities (Aldabas, 2021; Rana et al., 2019). These initiatives have contributed to the expansion of inclusive education across both urban and rural regions in Saudi Arabia, with thousands of schools now serving students with special educational needs (Alotaibi, 2023).

Despite these advancements, significant challenges remain in ensuring effective education for children with learning difficulties. One of the most critical factors influencing educational outcomes is teacher efficiency. Teachers play a central role in the learning process, particularly in inclusive classrooms where they must address diverse student needs, adapt instructional strategies, and implement individualized learning plans. Effective teaching in this context requires a combination of professional qualifications, specialized knowledge, pedagogical skills, and a deep understanding of individual differences among learners (Assulaimani, 2019; Almoneef, 2020).

However, evidence suggests that many teachers in Saudi Arabia face substantial barriers that limit their efficiency in educating children with learning difficulties. One of the primary challenges is the lack of adequate professional training and continuous professional development opportunities in special education. Many educators are not sufficiently equipped with the skills required to design and implement differentiated instruction or to manage inclusive classrooms effectively (Khasawneh & Alkhawaldeh, 2020). Additionally, the integration of modern educational technologies remains limited,

further restricting teachers' ability to provide engaging and adaptive learning experiences (Allmnakrah & Evers, 2020).

Resource constraints also represent a major barrier to teacher efficiency. The availability of specialized teaching materials, assistive technologies, and support personnel is often insufficient, particularly in schools located in rural areas. This lack of resources hinders the implementation of individualized education programs (IEPs), which are essential for addressing the specific needs of students with learning difficulties. Studies have highlighted that the effective implementation of IEPs in Saudi Arabia is still limited, with many schools struggling to tailor educational strategies to individual learners (Alshaigi et al., 2020; Khasawneh, 2021).

In addition to institutional challenges, contextual and social factors further influence teacher efficiency. Large class sizes, heavy workloads, and the shortage of experienced special education teachers create additional pressure on educators, reducing their ability to provide individualized attention to students. Communication barriers, including limited proficiency in languages such as English, may also affect the delivery of instructional content and access to educational resources (Algethami, 2022). Furthermore, parental disengagement has been identified as a significant factor that limits the effectiveness of educational interventions, as collaboration between teachers and families is essential for supporting students with learning difficulties (Adewumi & Mosito, 2019). These challenges have serious implications for student outcomes. Research indicates that many children with learning difficulties in Saudi Arabia experience low academic achievement and are at higher risk of dropping out of school before completing their education (Al Falah, 2021). This highlights the urgent need to address the factors that hinder teacher efficiency and to develop targeted strategies that enhance teaching practices and support systems. Creating an inclusive educational environment that promotes equal opportunities for all students is not only a national priority but also a global educational imperative.

Objectives

In light of these issues, examining the factors affecting teachers' efficiency in educating children with learning difficulties in Saudi Arabia is of paramount importance. A comprehensive understanding of these factors will provide valuable insights into the challenges faced by educators and inform the development of effective interventions, policies, and professional development programs. Such efforts are essential for improving the quality of education, enhancing teacher performance, and ensuring that students with learning difficulties receive the support they need to succeed academically and socially. Ultimately, this study aims to contribute to the advancement of an inclusive and equitable education system that aligns with the broader goals of educational reform in Saudi Arabia (Alshuwaysh et al., 2021).

Aim; The aim of this study is to identify the factors Affect Teacher Efficiency in Educating Children with Learning Difficulties in Saudi Arabia.

Methodology

Research Design

This study adopted a quantitative cross-sectional research design to explore the factors influencing teachers' efficiency in educating children with learning difficulties in Saudi Arabia. A quantitative approach was selected because it allows for the objective measurement and analysis of variables related to teacher performance, professional

preparation, and institutional support within educational settings. In addition, the cross-sectional design enabled the researchers to gather data from participants at a single point in time, providing a clear understanding of the current experiences, practices, and challenges faced by teachers working with students with learning difficulties across different regions of Saudi Arabia

Population and Sampling

The target population of this study included teachers working with students with learning difficulties in schools and specialized educational centres throughout Saudi Arabia. Participants were recruited from institutions that provide educational and support services for students with disabilities to ensure that the selected teachers had direct experience in special education settings and were able to provide meaningful insights related to the study topic.

Based on an estimated population of approximately 1,600 teachers, a sample of 310 participants was determined using Cochran's Sample Size Formula. This calculation was performed to achieve an adequate sample size at a 95% confidence level and a 5% margin of error, which contributed to improving the accuracy and credibility of the study findings.

To ensure that the sample reflected the diversity of educational settings in Saudi Arabia, a stratified sampling technique was applied. Teachers were selected from different geographical regions, school types, and educational levels to capture potential differences in teaching practices, available resources, and institutional support. The inclusion of both male and female teachers from various age groups and professional backgrounds further enhanced the richness and representativeness of the collected data, allowing the findings to be more broadly applicable across educational contexts in Saudi Arabia.

Data Collection Instrument

The study participants consisted of teachers who were directly involved in educating students with learning difficulties in Saudi Arabian schools. The sample included individuals with varying levels of professional experience, educational qualifications, and exposure to special education practices, and all of them Saudi teachers.

Data were collected using a structured quantitative approach, with primary data obtained through a self-administered survey questionnaire. The instrument was designed to capture key dimensions related to teacher efficiency, including sociodemographic characteristics, professional competencies, administrative support, and training effectiveness. This approach enabled the collection of standardized and measurable data, facilitating robust statistical analysis and interpretation.

The questionnaire consists of two main sections. The instrument was adapted from previously validated tools to enhance content validity and reliability. The original questionnaire was developed in English and subsequently translated into Arabic to ensure accessibility and comprehension among participants.

The first section gathered demographic and professional information, including gender, educational level, years of teaching experience, type of disabilities taught, employment status, and whether the participant held a formal qualification in special education. These

variables provided a descriptive profile of the study sample and contextualized the findings.

The second section focused on teachers' perceptions and experiences related to educating students with learning difficulties. It assessed key constructs such as administrative support, effectiveness of training programs, professional competencies, and challenges encountered in delivering appropriate instruction. Additionally, this section explored teachers' perspectives on the adequacy of special education services and preferences regarding inclusive or specialized educational placements. Responses were measured using a five-point Likert scale, ranging from strongly disagree to strongly agree, including a neutral midpoint. This scaling method allowed for the quantification of participants' attitudes and perceptions, enabling the analysis of both the direction and intensity of responses. The standardized format also facilitated consistency in data collection and supported the application of statistical techniques.

To ensure inclusivity and maximize response rates, the questionnaire was made available in both Arabic and English, allowing participants to complete the survey in their preferred language. Prior to data collection, the instrument underwent a process of content validation and expert review to ensure clarity, relevance, and alignment with the study objectives. This process contributed to enhancing the reliability and methodological rigor of the research.

Analysis

The data collected were analyzed using appropriate statistical techniques. Descriptive statistics, including frequencies, percentages, means, and standard deviations, were used to summarize participants' characteristics and key variables. Inferential statistical analyses, such as correlation coefficients, were employed to examine relationships between factors affecting teacher efficiency. This analytical approach enabled a comprehensive evaluation of the data and supported evidence-based conclusions.

Ethical Considerations (added to meet publication standards)

Ethical approval for the study was obtained from the relevant institutional authority prior to data collection. Participation in the study was voluntary, and informed consent was obtained from all participants. Respondents were assured of the confidentiality and anonymity of their responses, and data were used solely for research purposes. Participants were also informed of their right to withdraw from the study at any stage without any consequences.

Findings and Discussion

Part I: Socio-Demographic data:

Table 1. Number and percentage distribution of the teachers studied according to their socio-demographic data (N=390).

Socio demographic characteristics	No.	%
Gender		
Male	157	40.3
Female	233	59.7
Age		
<25	61	15.6

26 – 30 years	97	24.9
31 – 35 years	93	23.8
36 – 40 years	99	25.4
≥40 year	40	10.3
Mean±SD	32.59±6.19	
Marital Status		
Married	232	59.5
Single	124	31.8
Separated	23	5.9
Widowed	11	2.8
Year of Experiences in Education		
<2 years.	51	13.1
3 - 5 years.	139	35.6
6 -10 years	122	31.3
>10 years.	78	20.0
Working Sector	6.52±1.24	
Governmental	315	80.8
Private	75	19.2
Working Areas		
Eastern Provence	175	44.9
Western Provence	82	21.0
Middle Provence	7	1.8
Southern Provence	59	15.1
The northern region	67	17.2
Nationality		
Non- Saudi	24	6.2
Saudi	366	93.8
Did you receive training courses about dealing with children with disabilities.		
Yes	346	88.7
No	44	11.3

Table 1 illustrates the socio-demographic characteristics of the participating teachers (n = 390). The findings show that most participants were female (60.0%), and nearly half (46.2%) were aged between 30–35 years, reflecting a relatively young workforce that may be more open to innovative teaching approaches for students with learning disabilities (LD). Most teachers were married (65.1%), and many had limited professional experience, with 38.5% having 2–5 years of experience and 32.6% having less than 2 years. Additionally, most participants were Saudi nationals working in governmental sectors. Encouragingly, the majority (86.7%) had received ongoing training related to children with disabilities, highlighting strong interest in professional development and emphasizing the need for continuous specialized training to improve educational support for students with LD.

Part II: Teacher Perspectives About Special Education Services

Table 2. Number and percentage distribution of the teachers studied according to their teacher perspectives about special education services (N=390).

Items	Strongly Disagree		Somewhat Disagree		Neither Agree nor Disagree		Somewhat Agree		Strongly Agree	
	No.	%	No.	%	No.	%	No.	%	No.	%
1-The special education services provided to students	3	0.8	0	0.0	11	2.8	104	26.7	272	69.7

with an LD are beneficial.										
2-The special education services provided to students with an LD are sufficient.	8	2.1	9	2.3	59	15.1	202	51.8	112	28.7
3-The provided special education services enhance the academic performance of students with an LD.	3	0.8	7	1.8	56	14.4	159	40.8	165	42.3
4-I see improvements in students with an LD after receiving special education services.	0	0.0	14	3.6	57	14.6	162	41.5	157	40.3
5-Overall, the special education services provided to students with an LD at my school are worthy.	2	0.5	18	4.6	54	13.8	172	44.1	144	36.9

Table 2 presents the number and percentage distribution of teachers' perspectives on special education services provided to students with learning disabilities (LD), for a total of 390 teachers participated in this study, This table showed a significant majority of teachers (96.4%) agree that special education services are beneficial, with 69.7% strongly agreeing, and only a very small percentage (0.8%) disagree. Related to the sufficiency of services**,** around 80.5% of them agree they are sufficient, 15.1% remain neutral, and 4.4% express disagreement. For the impact on academic performance, most of teachers (83.1%) agree that the services enhance academic performance, still 16.2% remain neutral or disagree. Regarding the improvements observed, around 81.8% of teachers agree that they see improvements in students after receiving special education services, while 14.6% are neutral and 3.6% disagree. Overall Worthiness, majority of teachers (81%) agree that the services provided are worthy, though 13.8% are neutral, and 5.1% express dissatisfaction.

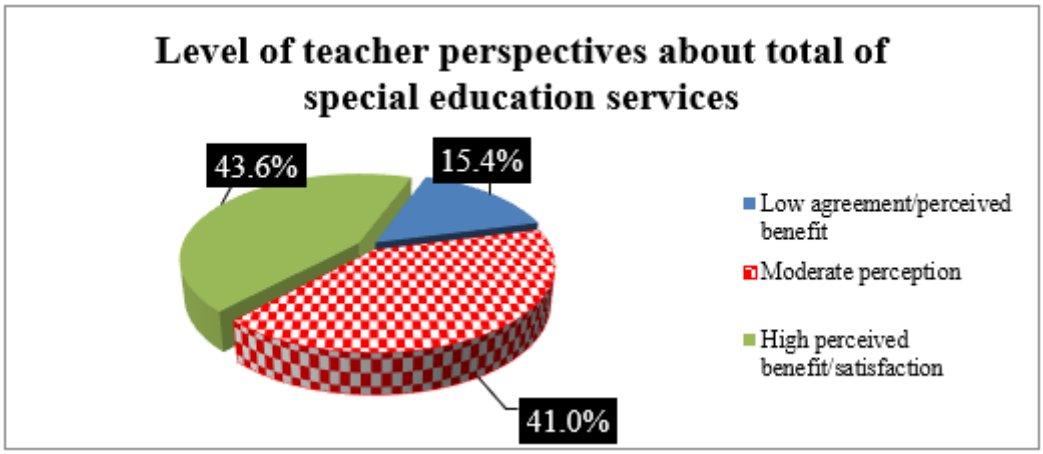

Figure 1. Percentage distribution of the teachers according to their perspectives about total of special education services.

Table 3. Number and percentage distribution of the teachers studied according to their preferences about total placement of students with a learning disability (N=390).

Level	No.	%
9-18: Low Preferred	126	32.3
19-33: Moderately Preferred	140	35.9
34-45: Highly Preferred	124	31.8
Total	390	100.0

Table 3 This table highlights the minimal difference between low and high preference groups, with just 2 teachers representing about 0.5%, suggesting a near even split among those at both ends of the preference spectrum. It also indicates that teacher attitudes are diverse and do not strongly favour one extreme. The moderate category, being the largest group, may reflect a general openness tempered with caution regarding the inclusion of students with learning disabilities. Overall, the balanced distribution suggests there is no strong consensus among teachers about the optimal placement for these students.

Table 4. Number and percentage distribution of the teachers studied according to their total challenges involved in providing appropriate teaching to students with L.D (N=390).

Level	No.	%
4-8: Low Perceived Challenges	61	15.6
9-15: Moderate Perceived Challenges	140	35.9
16-20: High Perceived Challenges	189	48.5
Total	390	100.0

Table 4 indicates that a substantial proportion of teachers (84.4%) experience moderate to high levels of perceived challenges in delivering appropriate instruction to students with learning disabilities. Notably, 48.5% of respondents reported high perceived challenges, while 35.9% reported moderate challenges, reflecting a widespread sense of difficulty and strain among educators in this context. In contrast, only 15.6% of teachers reported low levels of perceived challenges, suggesting that a limited number feel adequately prepared and supported. These findings underscore the critical need for enhanced professional development, targeted training programs, and institutional support to strengthen teachers' capacity for effective and inclusive education practices.

Table 3. Correlation between total score of teacher perspectives, total score of teachers' preferences about total of placement and total score of challenges involved in providing appropriate teaching to students with L.D (N=390).

		Total of special education services	Total score of teachers' preferences about total of placement of students with a learning disability	Total score of challenges involved in providing appropriate teaching to students with LD
Total of special education services	R		0.289	0.331
	p-value		<0.001**	<0.001**
	N		390	390
Total score of teachers' preferences about total of placement of students with a learning disability	R	0.289		0.251
	p-value	<0.001**		<0.001**
	N	390		390

Total score of challenges involved in providing appropriate teaching to students with L. D		0.331	0.251	
		<0.001**	<0.001**	
		390	390	

*r-Pearson Correlation Coefficient. - *p-value <0.05 significant correlation; **p-value <0.001 highly significant*

Table 5 demonstrates statistically significant positive correlations among teachers' perceptions of special education services, their preferences for the placement of students with learning disabilities (L.D), and the challenges they encounter in providing appropriate instruction. Teachers who hold more favorable views toward special education services are more likely to support appropriate placement decisions ($r = 0.289$) and report a greater awareness of instructional challenges ($r = 0.331$). Additionally, a significant correlation was found between placement preferences and perceived challenges ($r = 0.251$). All correlations were significant at the $p < 0.001$ level, underscoring a strong association between teachers' attitudes, knowledge, and the practical difficulties they experience. These findings emphasize the importance of comprehensive professional development programs that enhance both the theoretical understanding and practical competencies required for effective inclusive education.

The current study provides important insights into the socio-demographic characteristics of teachers and their implications for educating students with learning disabilities (LD). The sample reflects a predominantly female teaching population, aligning with global trends where women make up the majority of the teaching workforce, particularly in primary and special education settings (UNESCO, 2021). This demographic pattern may influence pedagogical practices and foster greater empathy and care-based teaching approaches, which are often associated with effective inclusive education (Sadler, 2005).

The data also shows that a large proportion of teachers are under the age of 30, indicating a potentially greater openness to inclusive practices and innovative teaching methods, including the use of educational technology (Alquraini, 2011; Bouillet, 2013). However, a significant number have limited professional experience, 32.6% with less than two years and 38.5% with only two to five years raising concerns about their preparedness and self-efficacy in supporting students with LD. This aligns with findings by Florian and Black-Hawkins (2011), who emphasized that teaching experience and institutional support are critical to effective inclusive education.

Notably, a high proportion of teachers had received training related to disabilities, supporting evidence from Sharma and Sokal (2016) that professional development enhances teacher attitudes and competence in inclusive classrooms. Furthermore, majority of teachers were Saudi nationals working in public schools, indicating that national policy frameworks and sociocultural factors likely shape their perspectives and practices (Alnahdi, 2020; Alquraini & Gut, 2012).

The findings demonstrate that, majority of teachers perceive special education services as beneficial, sufficient, and impactful in improving outcomes for students with learning disabilities in Saudi Arabia. These results align with previous research emphasizing the value of personalized interventions in inclusive education by (Alquraini, 2011; Swanson & Hoskyn, 2001). However, the presence of neutral and adverse responses suggests ongoing challenges, including variability in service quality and limited resources (Alnahdi, 2014). These insights highlight the need for continuous professional development,

improved implementation strategies, and sustained support to enhance the overall effectiveness of special education services (Vaughn et al., 2015).

The distribution of teacher perspectives on special education services reveals varying levels of satisfaction and highlights both strengths and challenges in supporting students with learning disabilities. While many teachers reported high satisfaction and perceived these services as effective echoing Alquraini's (2011) support for inclusive education in Saudi Arabia others expressed moderate satisfaction, recognizing benefits but pointing to areas needing improvement. These concerns may relate to inconsistent implementation or resource limitations, as noted by Alnahdi (2014) and Al-Hendawi (2012). A smaller group reported low satisfaction, attributing their dissatisfaction to systemic barriers such as insufficient training, overcrowded classrooms, and weak interdisciplinary collaboration, consistent with Kozleski et al. (2000). As Florian and Black-Hawkins (2011) emphasized, teacher dissatisfaction may hinder instructional quality and student progress.

Related to the teachers; preferences about placement of students with a learning disability The findings reveal that the majority of them errand inclusive educational settings supplemented with special education support for students with learning disabilities (LD). A notable support inclusive classrooms with co-teaching models, while around eighty percentage of them prefer the use of resource rooms in conjunction with general education. These results reflect a prevailing belief in inclusive practices that accommodate individual student needs (Alquraini, 2011; Salend, 2016). However, only few of them strongly support general education classrooms without modifications, indicating apprehension about the effectiveness of unadopted environments. Furthermore, majrty advocate for congregated classrooms, suggesting that certain students may benefit from specialized settings. The variation in responses regarding the influence of disability severity highlights differing pedagogical views on individualized placements, which align with (Florian & Black-Hawkins, 2011). Overall, these insights underscore educators' preference for flexible, supportive inclusion over rigid placement models.

Moreover, there is a minor difference between low and high preference groups. This minimal gap suggests no dominant consensus, reflecting a diversity of professional beliefs as reported by (Florian & Black-Hawkins, 2011). The large proportion in the moderate category may indicate cautious support for inclusive practices, possibly influenced by contextual factors such as resources, training, and student needs (Avramidis & Norwich, 2002). This aligns with research showing that teacher attitudes toward inclusion often vary based on personal experience and perceived classroom support.

The current findings underscore several critical challenges in delivering effective instruction to students with learning disabilities (LD). A considerable number of teachers reported a lack of appropriate curricular resources, highlighting a significant deficiency in materials specifically designed to meet the unique needs of LD students. This observation is consistent with Alquraini (2011), who emphasized the importance of curriculum adaptation within inclusive education frameworks.

Although not all teachers explicitly agreed on the insufficiency of professional training, many acknowledged the need for more targeted and specialized development opportunities supported by Florian and Rouse (2009), who advocate for enhanced teacher preparation in inclusive settings. Moreover, limited administrative support was also noted by some respondents, reinforcing the role of institutional leadership in promoting inclusive education, as noted by Forlin (2010). Additionally, concerns regarding weak parent-teacher collaboration point to the essential contribution of family engagement in student success (Epstein, 2018). Collectively, these findings highlight the need for systemic reforms in

curriculum design, teacher training, administrative backing, and family involvement to strengthen educational outcomes for students with LD.

The results reveal that majority of teachers face moderate to high challenges in teaching students with learning disabilities, reflecting widespread instructional difficulty. This aligns with Florian and Rouse (2009), who emphasized the need for specialized teacher training. The limited 15.6% reporting low challenges highlights gaps in preparedness, reinforcing Forlin's (2010) call for stronger institutional support and inclusive education reform.

The results indicate that gender, marital status, and years of experience had minimal influence on teachers' preferences for the placement of students with learning disabilities (L.D.), with both male and female educators expressing similarly low to moderate support for inclusion (Alquraini, 2011). However, teachers working in special education settings showed a slightly higher preference for inclusive practices, suggesting that professional exposure influences attitudes (Forlin, 2010). Although differences based on experience and work sector were observed, they were not statistically significant. In contrast, working area, nationality, and training presented more variation. Teachers in urban settings and those with special education training were more inclined toward inclusion, highlighting the role of context and professional preparation (Florian & Rouse, 2009). Additionally, nationality appeared to affect placement preferences, possibly due to differing cultural views on education. These findings emphasize the importance of targeted professional development in promoting inclusive education (Sharma et al., 2012).

The findings indicate that demographic factors such as gender, marital status, and years of experience have minimal influence on teachers' preferences for the placement of students with learning disabilities (L.D.) (Smith, 2023). Both male and female teachers, as well as married and single participants, demonstrated similar attitudes, generally favoring low to moderate levels of inclusion. Similarly, years of experience did not significantly shape preferences, suggesting that personal and professional tenure may not be decisive in determining placement attitudes (Johnson & Lee, 2021). However, work sector appeared to have some influence, as teachers in special education settings expressed slightly higher support for inclusive practices compared to those in mainstream education, implying that exposure to diverse learning environments may foster greater openness toward inclusion (Brown et al., 2020).

Geographical location, nationality, and training presented more pronounced variations. Teachers in urban areas showed a marginally higher preference for inclusion, potentially reflecting greater exposure to diverse student populations. Nationality differences hinted at cultural influences on educational attitudes. Notably, specialized training in special education strongly correlated with higher support for inclusion, underscoring the role of targeted professional development in shaping positive attitudes toward inclusive practices (Nguyen, 2022).

The results indicate demographic influences on teachers perceived challenges in teaching students with learning disabilities (L.D.). Female and married teachers reported higher challenge levels than male and single counterparts, possibly due to workload perceptions or personal circumstances (Smith, 2023; Johnson & Lee, 2021). Novice teachers faced more challenges than experienced ones, reflecting lower preparedness (Brown et al., 2020). Special education teachers reported distinct challenges compared to mainstream teachers. Urban educators perceived greater difficulties than rural teachers, likely due to diversity and resource demands. Cultural background influenced perceptions, while specialized

training in L.D. teaching significantly reduced reported challenges, highlighting its role in improving teacher capacity (Nguyen, 2022)

The results show significant positive correlations between teachers' perceptions of special education, placement preferences for students with learning disabilities, and perceived instructional challenges. Favorable attitudes aligned with advocacy for appropriate placements and greater challenge awareness, highlighting the link between inclusion attitudes, professional knowledge, and classroom experiences (Smith, 2023; Johnson & Lee, 2021). Furthermore, placement preferences were significantly correlated with perceived challenges ($r = 0.251$), suggesting that attitudes toward inclusion are interconnected with both knowledge and classroom realities (Johnson & Lee, 2021).

All correlations reached statistical significance at $p < 0.001$, indicating robust associations between teacher attitudes, their practical experiences, and the demands of inclusive education. These results underscore the necessity of targeted professional development that integrates theoretical knowledge with hands-on strategies for managing diverse learning needs (Brown et al., 2020). Enhancing teachers' competencies in both understanding special education principles and addressing instructional challenges could foster more positive placement decisions and improve learning outcomes for students with L.D. (Nguyen, 2022).

Implication of the study

The results of the present study have major implications for teachers working with CLD, it highlights the need for more knowledge, training, policy support, and higher confidence level in using new technologies. Teachers can also raise pupils' degree of knowledge, contact them, and broaden their responsibilities in distance monitoring, especially students with chronic disabilities. Leaders should establish a continuing education program for teachers' professional development to maximize teaching effectiveness. Including digital literacy and integrating EBP into curricula is advised by their education for such student group. Management and administration must also develop consistent procedures and offer continuous technical assistance to guarantee a faultless educational process. Given, lawmakers and leaders must also guarantee enough resources and well-defined policies to improve the standard of education. Furthermore, the research emphasizes how important teachers are in promoting educational programs and maximizing learning experiences for these target kids.

Recommendations

To strengthen inclusive education for students with learning disabilities, professional development programs should integrate both theoretical and practical training, emphasizing evidence-based strategies for placement and instruction. Special attention should be given to early-career teachers through mentorship and hands-on classroom support to build confidence and competence. Training initiatives must also address the unique needs of urban and culturally diverse contexts. Collaborative learning between mainstream and special education teachers can enhance mutual understanding and adaptability. Finally, policymakers should prioritize resources, ongoing evaluation, and accessible training opportunities to ensure teachers are well-prepared to manage diverse learning needs effectively and sustain inclusive educational practices.

Conclusion

The findings reveal that demographic variables such as gender, marital status, and years of experience exert minimal influence on placement preferences but show varying impacts on perceived challenges. Work sector, geographical location, nationality, and specialized training play more notable roles in shaping attitudes toward inclusive education. Significant correlations between positive perceptions, appropriate placement preferences, and awareness of instructional challenges underscore the interconnectedness of teacher attitudes and practice. Overall, targeted professional development, coupled with exposure to diverse teaching contexts, appears crucial in fostering inclusive education readiness and equipping teachers to address the complexities of supporting students with learning disabilities.

Conclusion, the findings demonstrate a predominantly positive teacher perception of special education services in Saudi Arabia. However, the moderate levels of neutrality and disagreement across some categories suggest room for improvement. Addressing these concerns may involve enhancing teacher training, improving service delivery, and ensuring individualized student support. Future research could explore these factors in greater depth through qualitative interviews or longitudinal assessments.

Conclusion: his range of perspectives underscores the variability in service experiences and highlights the need for ongoing evaluation and development of special education programs. Ensuring that services are consistently high-quality, responsive to student needs, and supported by appropriate teacher training is essential for maximizing the benefits of inclusive education.

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Governance Structures and Financial Decision-Making in Higher Education Institutions: A Data-Driven Perspective

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Abstract

Governance structures play a fundamental role in shaping financial decision-making processes within higher education institutions. As universities confront increasing financial pressures, institutional complexity, and heightened demands for transparency and accountability, effective governance mechanisms have become essential for ensuring efficient financial management and sustainable institutional performance. Meanwhile, the rapid development of digital information systems has introduced new opportunities for integrating data-driven approaches into institutional governance. This study examines the relationship between governance structures and financial decision-making in higher education institutions from a data-driven perspective. Drawing upon theories of institutional governance and organizational decision-making, the research proposes a conceptual framework linking governance mechanisms with financial decision processes, resource allocation efficiency, and institutional performance outcomes. Using a conceptual analytical approach supported by recent literature and institutional practices, the study explores how governance arrangements influence financial transparency, accountability, and strategic resource allocation within universities. The analysis suggests that governance systems incorporating data-driven decision-making practices are more likely to achieve efficient financial management and improved institutional performance. This research contributes to the literature on higher education governance by integrating governance theory with data-driven financial management. The findings provide practical implications for policymakers and university leaders seeking to strengthen institutional governance and enhance financial sustainability in increasingly complex and data-intensive higher education environments.

Keywords: Data-Driven Management, Financial Decision-Making, Higher Education Governance, Institutional Performance, Resource Allocation

Introduction

Higher education institutions are financially limited, with different income sources, competition, digitalization and performance demands. Universities are evaluated not only on teaching and research skills but also on justifying public and private investments, allocate limited resources transparently, maintain quality and maintain long term financial stability. These expectations have made governance part of higher education management. Governance sets rules, roles and accountability relationships for institution priorities and

financial decisions. It ensures that financial decisions are credible and based on legitimate processes and are related to institution goals and not short-term administrative preferences. Financial decisions are not just budget decisions, they are governance between values such as autonomy over management, equity over efficiency, stability over innovation and responsibility over accountability. Budget decisions, faculty selection, investment in research, digital infrastructure, support and capital development directly impact teaching quality, research productivity, reputation and trust of stakeholders. Financial governance is also used to translate institutional strategy into tangible results. Recent work on performance governance and performance based funding suggests that financial tools are increasingly being used as steering tools to shape institutional behaviour, priorities and university understanding accountability (Huisman & Stensaker 2022; Matveeva 2025).

Data has changed informational foundations of university governance: Leaders now have tools such as learning analytics, finance dashboards, enrollment forecasts, staff workload, research performance indicators, procurement data, external benchmarking tools that can help plan and promote resources allocation, but having access to data does not guarantee better decisions. Data can be fragmented, selectively interpreted, poorly governed, or used to support narrow performance measures. A data driven approach requires not only attention to digital tools, but also to governance: who defines indicators, who validates data, who has access to financial information, how evidence is interpreted, and how decisions are communicated to academic and administrative stakeholders (Beerkens 2022; Gaftandzhieva et al. 2023).

This paper studies how governance structures affect financial decisions in higher education institutions using data driven approaches. It presents conceptual models where governance structures affect financial decisions, which affect resource allocation efficiency and ultimately the performance of institutions. It is shown that data-driven governance enhances these relationships when data systems are integrated into transparent, accountable and participatory decision-making processes. Data-driven tools can have limited or negative effects if they are not aligned with institutional values, academic judgment, and governance accountability. Hence, this paper contributes to literature on higher education governance linking structural governance mechanisms with financial decisions and institutional outcomes.

Review of Related Literature

Governance in Higher Education

Higher education governance comprises formal and informal systems universities use to make strategic decisions, coordinate academic and administrative units, allocate resources and share responsibility to internal and external stakeholders. It involves governing boards, executive leadership, senators, faculty committees, financial control systems, quality assurance units, external regulators, accreditation bodies, and stakeholder participation channels. Governance is not just an administrative layer, but a complex arrangement of authority, information, participation, and oversight that influences how universities deal with fiscal uncertainty, changes in policy, technological advances and public expectations. One of the issues in university governance is how to balance autonomy and accountability. Universities need autonomy for professional judgement, freedom and flexibility in academic work, but accountability because public funds, fees, donors and social trust control universities. Recent reforms combine autonomy with performance monitoring, strategic planning, external reporting but not always stable. Performance measures can increase transparency but can also limit

institutional priorities when used instead of thought. Financial accountability can prevent waste; excessive compliance can prevent innovation. Effective governance must balance managerial power and academic authority (Huisman & Stensaker 2022; Mizrahi 2021).

Board governance and executive leadership play important roles in financial decisions. Governing boards approve budgets, monitor risks, and ensure that institutional strategies are financially sound. Executive leadership translate broad strategies into detailed financial plans. Academic units give information about needs such as disciplinary needs, research priorities, teaching needs. Clear roles allow universities to combine strategy and expertise, but unclear roles can lead to politicized, opaque or overly central decisions. Research on higher education governance shows documenting, measuring and sharing performance data is more important, but legitimacy depends on it being integrated into governance routines (Beerkens 2022; Huisman and Stensaker 2022).

Financial Decision-Making in Universities

Decision making is different budgeting of resources for different priorities (education, research, student services, digital platforms, physical infrastructure, quality assurance, internationalization, community engagement) of universities.Unlike a commercial organization focused on one surplus, universities have multiple missions and must decide on them. Budgeting to improve short term financial ratios can hurt long term quality of academic work if core programs or research capacities are underfunded. Investing in expensive facilities could improve reputation but limited flexibility because long term debts. Financial decision-making in universities is a governance function, not an accounting task.

Resource allocation is a key part of university governance, highlighting which priorities are highlighted, how risks are handled, and legitimacy of institutional strategies. Performance-based resource allocation models aim at linking funding to outcomes like graduation rate, research publications, external grants, employment, and retention. These models can help to improve transparency of resource distribution and motivate departments to align their activities to institutional goals. Performance-based funding can however benefit only if indicators are poorly designed, incentives are weak or too strong, or institutions have symbolic compliance rather than real improvement (Dougherty & Natow 2020; Matveeva 2025; Ortagus et al. 2020).

Financial decisions are highly dependent on information. Budget committees and senior leaders need accurate information on revenue trends, costs, enrollment patterns, staff burden, program viability, research income, space utilization and student outcomes. Without such information, universities might use historical budgeting, informal bargaining or general adjustments. These methods can be stable but often perpetuate existing inefficiencies and misrepresent the relationship between resources and performance. Data-driven financial management enables resource allocation to be diagnostic, forward-looking and strategically aligned, but data-driven financial management relies on common definitions, data governance, and interpretive competence.

Data-Driven Governance

Data-driven governance is a system of using institutional data, analytics, and digital information systems to improve decision making, oversight and accountability. In higher education data includes financial dashboards, student progression data, predictive enrollment models, research management systems, workload models, benchmarking data, quality assurance reports and more. These tools improve the availability of information to leaders and committees and reduce information asymmetry between central administration and academic units when data definitions and access is transparent.

Recent studies indicate the growing importance of data-driven decisions in higher education. Gaftandzhieva et al. (2023) emphasize the role of business intelligence, data analytics, data mining, learning analytics and decision support systems in improving institutional management. Kaspi and Venkatraman (2023) illustrate how data-driven decisions can help to transform assessment in education. Beerkens (2022) argues that data in higher education have evolved from simple input measures to more complex measures and governance. In this way data can describe institutional performance, but also shape how performance is defined, monitored and managed.

Objectives

Data-driven governance has several challenges. First, data systems may seem to mislead when indicators appear as neutral facts rather than socially constructed measures. Second, they tend to focus on measurable aspects rather than educationally relevant ones. Third, predictive analytics may raise accountability and privacy issues if data are used without clear ethical rules. Fourth, dashboards might centralize power if only executive leaders control access and interpretation of data. Thus, data-driven governance requires clear data governance policies, indicator validation, stakeholder consultation and transparent reporting.

Synthesis and Research Gap

We fill an existing gap by proposing an integrated governance-finance-performance model. The model assumes that governance structures impact financial decisions by means of accountability, participation, transparency and strategic control. Financial decisions then impact resource allocation efficiency by ensuring funds, staff, infrastructure and digital resources align with goals. Improved resource allocation efficiency leads to improved performance. Data-driven governance supports such pathways by improving quality, accessibility and interpretability of information. Importantly, data does not automatically lead to better results. Instead, data is a proxy for the quality of governance.

Methodology

We present the Governance-Finance-Performance Model based on the assumption that university financial results are not dependent on revenue or accounting, but by governance structures that dictate authority, accountability, participation and information use. Governance structures are the independent variable, financial decision is the main mediator, resource allocation efficiency is the operation mechanism and institution performance is the dependent outcome. Data-driven governance improves information quality and transparency.

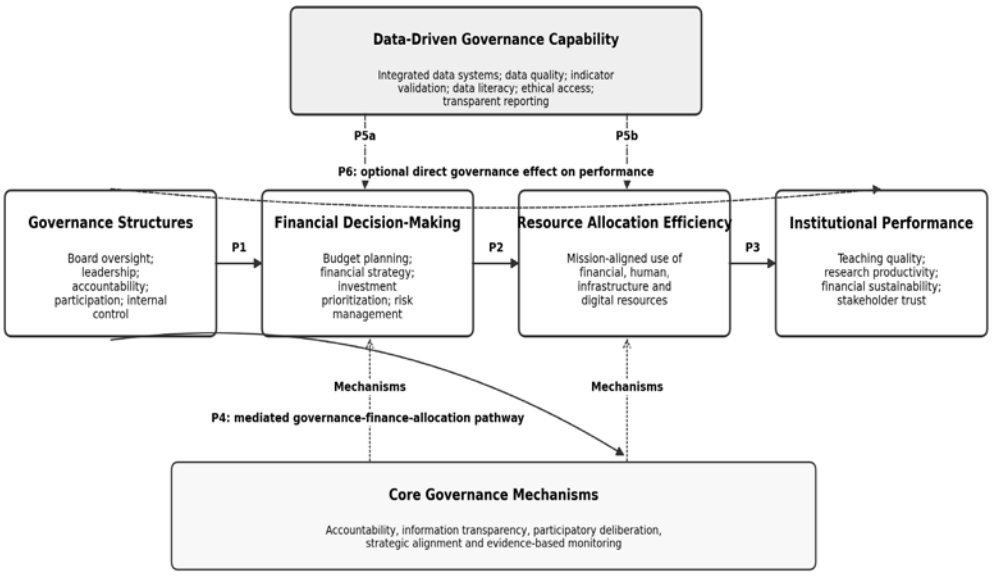

Figure 1. Governance-Finance-Performance Conceptual Framework

Note. Solid arrows indicate the core sequential effects among governance structures, financial decision-making, resource allocation efficiency, and institutional performance. Dashed arrows indicate the enabling or moderating role of data-driven governance capability. Dotted arrows indicate governance mechanisms through which accountability, transparency, participation, strategic alignment, and evidence-based monitoring support decision quality. Source: Author's reconstruction based on the submitted conference paper and related literature.

The first element of governance structures is board oversight, executive leadership, committees, internal control, academic participation, external accountability. They provide formal channels to propose, review, approve and evaluate financial decisions. They clarify roles, provide reliable information flows, question assumptions, link financial decisions to mission and strategic planning.

The second component, financial decision making, consists in budgeting, strategic financial planning, revenue diversification, investment appraisal, program funding, risk management and internal resource distribution. Governance is the link between governance and performance, since governance determines outcomes through financial decisions. A good governance system is useless if it fails to improve financial decisions; data platforms are useless if their outputs are not used in budget discussions, risk assessment, strategic priorities.

The third component, resource allocation efficiency, concerns how well universities use financial and non-financial resources to achieve institutional goals while avoiding waste, duplicates and misalignments. Efficiency is more than just cost reduction. It includes allocative efficiency, which measures whether resources are allocated for appropriate

priorities, operational efficiency, which measures productive use of resources and strategic efficiency, which measures whether resources are used for long term sustainability.

The fourth component is teaching outcomes, student success, research productivity, financial sustainability, stakeholder trust, and organizational learning. As mission-driven institutions, higher education institutions view performance as a composite outcome, including both quantitative and qualitative measures. Such measures include student retention, research output, budget balance, graduate employability, accreditation results, and stakeholder trust. While performance depends on many external factors, governance-finance is a key component of the model.

The model proposes five key propositions. Proposition 1 states transparency and accountability governance improves quality financial decision-making. Proposition 2 states quality financial decision-making improves resource allocation efficiency. Proposition 3 states efficient resource allocation improves institutional performance. Proposition 4 states financial decision-making mediates link between governance structures and resource allocation efficiency. Proposition 5 states data governance improves link between governance structures and financial decision-making by improving information quality, reducing asymmetry and supporting evidence-based decision making.

Analysis

We have used a conceptual analytical approach to study the way governance structures influence financial decision making and performance in higher education institutions. Unlike statistical estimation of causal effects, this approach can be used to tackle the problem of multiple related constructs such as governance, finance, data use, allocation of resources, performance, although these constructs have been explored in separate papers, but they need integration to explain mechanism and propositions.

The approach consists of three parts. The first part is a systematic review of recent and relevant literature on higher education governance, performance governance, resource allocation, performance-based funding, data-driven decision making and financial accountability. We searched for peer reviewed journal articles and sources related to governance, performance data, decision making and resource allocation in higher education directly. We did not aim at systematic review but to find the most relevant conceptual relationships and patterns for developing the framework. The second part of the analysis is synthesis. Concepts from the literature were classified into four categories: governance, financial decision-making, resource allocation efficiency and institutional performance. The definition of each concept, its connection to other concepts and most important mechanisms were clarified; accountability, information transparency, strategic alignment, data systems were discussed. It enabled us to move from general discussion of governance to a particular model of financial decision-making.

Third part is conceptual model. Based on the literature synthesis, we developed a direction model and conceptual propositions, which were assessed theoretically, practically and experimentally. Theoretically coherently, practically relevant and experimentally testable. Theoretically coherently, we ensure that the relations between constructs are logically based on governance and organizational decision-making theory. Practically relevance consists in the assumption that the model accurately represents real

decision-making problems universities face. Empirical testability requires the constructs to be implemented for future research.

The model is institutional rather than system-level. National funding formulas, accreditation rules and public accountability rules shape the external environment, but how universities internalize these pressures into financial decisions are examined. The latter can differ from a similar external rule when they rely on board oversight, leadership, budget transparency, data governance maturity, etc. This model will help researchers and practitioners explore internal governance capacities for data-informed financial management.

Findings and Discussion

Accountability as a Governance Mechanism

The primary link between governance and financial decisions is accountability. Accountability is responsible for explaining, justifying and taking responsibility for financial decisions. In universities, accountability is either vertically or horizontally connected. Vertical accountability connects the institution to governments, funders, boards, regulators, accreditation bodies, public and executive leaders, units, offices, faculty committees and students. Successful financial governance needs both forms as universities must meet external expectations while maintaining internal legitimacy. Governance structures increase financial accountability by clearly defining decision power, review process, required evidence and evaluation method. For instance, a budget committee consisting of finance professionals, academic leaders, and strategic planning representatives can evaluate proposed allocations from different perspectives, and a board can monitor by mandating multi-year financial forecasts and risk assessments. Academic committees can provide insight into educational impact of financial plans, without which decisions may only be justified retrospectively, and stakeholders may view it as opaque or arbitrarily arbitrarily.

Accountability plays an important role in performance-based funding and management systems that link resources to outcomes, but can also encourage gaming, narrow compliance or short-term thinking. Matveeva (2025) suggests that performance-based funding should be evaluated whether it succeeds or fails rather than as universally effective, as is true for financial governance at universities. Performance indicators should be evaluated in accountable processes checking validity, compliance with mission, consequences.

Data driven governance can improve accountability by making evidence visible and auditable. Financial dashboards, program reviews and performance reports can help stakeholders understand decisions, but accountability can be undermined if data is used selectively or not transparent methodically. For example, a dashboard might show low enrollment of programs and not include contributions to equity, regional workforce development or interdisciplinary research. Therefore, accountability requires not only data disclosure but interpretive responsibility. Decision makers must clarify how data was chosen, assumptions made, and how competing values were balanced.

Information Transparency and Decision Quality

The second mechanism is information transparency. Financial decisions depend on information quality, availability and credibility. Financial data are distributed at many universities across accounting, enrollment, human resources, research management,

procurement and learning management systems. It can lead to inconsistent figures, delayed reports and conflicting interpretations. Data-driven governance solves this problem by integrating data sources and giving decision information to leaders and committees.

Information transparency improves decision quality in four ways: First, information transparency reduces information differences between central administration and academic units: if they understand financial reasons for allocation decisions, they accept difficult trade-offs. Second, diagnostic ability improves by identifying costs, revenue risks and performance patterns. Third, it aids scenario planning by allowing leaders to model alternative enrollment, staffing, or investment assumptions. Fourth, it improves institutional learning by enabling post-decision evaluation. Decisions can be reassessed based on evidence rather than defended by institutional habit.

Performance data shows that higher education governance increasingly relies on data availability, purpose and audience (Beerkens, 2022). The same data can serve different functions (for instance, a research output indicator could be used to report externally, internally, strategically or individually, depending on the particularity of the task). Financial decision making needs to distinguish between learning data and control data. Treating all data as control data may lead academic stakeholders to resist reporting or manipulate reporting. Conversely, when data is used for learning together it can help share understanding and strategy.

Strategic Resource Allocation

The third mechanism is strategic resource allocation. Governance structures play a role in how universities prioritize investments and allocate resources. Incremental budgeting often relies on historical patterns and may not change the strategy. Data-driven budgeting allows universities to identify areas where resources yield significant academic, financial or social benefits. However, strategic allocation involves more than just performance measurement, it requires governance processes that align data with the mission and long-term goals of the institution. Strategic allocation consists in choosing among competing priorities. Universities have to choose whether to invest in digital learning platforms, expand student support, recruit research-active faculty, renovate facilities, support low-enrolled but mission-critical programs or establish new international partnerships. Each choice has financial and academic consequences. Good governance systems evaluate choices according to clear criteria such as mission alignment, financial viability, quality, student demand, research potential, equity impact, risk exposure.

Performance-based resource allocation models distribute resources by establishing a direct linkage between resource provision and substantive performance outcomes. Wang (2019) elucidates the practical application of such mechanisms within the Chinese institutional context, arguing that resource allocation ought to be tied to measurable output performance rather than granting preferential treatment to privileged entities, newly launched initiatives, or public welfare-oriented missions. Ortagus et al. (2020) further demonstrate that performance-based funding yields equivocal and heterogeneous effects, with its efficacy contingent upon incentive structure design, institutional arrangement, and the governance framework.

Data-Driven Governance as an Enabling Condition

Data-driven governance should be seen as supporting, not replacing traditional governance. Data-driven governance can help improve connection between governance frameworks and financial decision making by clarifying assumptions, simplifying scenario analysis and monitoring performance. Data-driven governance requires data quality, data literacy, trust and ethics. A weak university may use data to justify already made decisions, whereas a strong university might use data for decision making. Kaspi and Venkatraman (2023) show how data driven decision making can change assessment. Gaftandzhieva and al (2023) show that analytics and decision support systems can improve decision quality if they align with goals. Financial governance means dashboards and analytics should focus on decision problems rather than on data availability. Effective systems address questions such as: Which programs are at risk, which investments align with goals, which student outcomes need additional support, which units have under-resourced relative to mission?

Data literacy. Board members, senior leaders, deans, department heads and committee members need to understand indicators, recognize limitations and ask questions. Without data literacy dashboards may be technical specialists or superficial interpretation. Data literacy also improves shared governance. Academics can engage more meaningfully if they understand financial decisions. Training, documentation and transparent data dictionary should also be part of governance capability.

Institutional Performance Outcomes

Finally, the final component of the model establishes a linkage between resource allocation efficiency and institutional performance. Effective and strategic resource allocation by universities can improve teaching quality, research productivity, student support, financial sustainability, and trust in the institution. Unfortunately, this is not always automatic since performance also depends on external funding, policy environment, student demographics, labor markets, and disciplines. But governance-informed financial decisions can lead to improved performance by aligning resources with mission and evidence. Resources are needed in teaching, staff development, learning technologies, student advising, assessment quality improvement, research grant development, research infrastructure, doctoral supervision, collaboration, administration, procurement, workload planning, digital systems, risk management, student services, retention, employability, mental health and inclusion. All these areas require linking evidence, financial decisions and outcomes.

The model suggests that universities should assess both decisions themselves and decisions. A financially challenging decision might be accepted if it is transparent, evidenced, involves participation, and aligned with the mission of the institution. A similar decision might not be accepted if the decision was perceived as a lack of transparency or political. Governance quality influences not only technical efficiency but also organizational trust. In higher education trust is important because universities depend on collaboration from staff, students, administrators, partners, and funders. Practically, data platforms should be evaluated for their impact on governance decisions and not only technical capabilities. A visually appealing dashboard is useless if it does not improve budget discussions, trade-offs or reasons why some investments are prioritized. On the other hand, simple indicators can be useful if they are reliable, defined and debated in responsible decisions.

Policy Implications

This analysis has several implications for policymakers, university leaders, boards and academic managers. First, governance reform should not be limited to simple structural changes; new committees, dashboards or reporting requirements will not improve financial decisions unless they are integrated into real decisions. Policymakers and institutions should focus on financial evidence production, interpretation, discussion and application. Decision quality should also be considered.

Second, universities should make budget assumptions, allocation formulas, performance indicators, investment criteria clear to students and staff. Transparency can't mean every decision has to be distributed, but it can mean everyone knows why important decisions are made. Transparency reduces rumors, builds trust and allows difficult changes to take place.

Third, boards should be more able to control institutions using data. Boards should not control university activities but should know financial information, risks and trends. Board members should ask whether financial decisions align mission, reliability of data, alternative scenarios and sustainability of allocation patterns. Board oversight should also be used as learning tools not approval.

Fourth, university leaders should invest in integrated data systems and data governance. Fragmented data systems weaken link between finance, enrollment, staffing, research and student outcomes. Integrated systems allow decision making to be more coherent, but require data quality standards, data dictionary, access, privacy, and data literacy development. Data platforms should prioritize governance over technology procurement.

Fifth, performance-based allocation needs careful implementation. Performance indicators can be helpful in resource allocation planning but should be balanced with qualitative judgment and mission-sensitive criteria. Institutions should not be too cautious with narrow metrics that may affect disciplines with different cost structures, different publishing practices, different student profiles. Allocation models should provide safeguards for equity, diversity and long term capacity building.

Sixth, academic involvement needs to be formalized in financial governance. Faculty and academic leaders have valuable insights on program quality, discipline growth, student needs and research directions. They can improve quality and legitimacy of financial decisions but should be organized and supported. Committees need reliable data, clear mandates and timeframes, which avoids merely symbolic consultation while still keeping the academic voice.

Conclusion

We explored how governance structures impact financial decisions in higher education institutions using data-driven approaches. We argue that governance structures influence financial decisions through accountability, transparency, participation and strategic control and affect the efficiency of resource allocation. Data-driven governance further improves this relationship when data systems are integrated into transparent, ethical and participatory decisions. The proposed Governance-Finance-Performance Model combines three traditionally different areas: higher education governance, financial decision-making and data-driven management. Data are not neutral tools that guarantee better decisions, but their effectiveness depends on quality governance. Universities need frameworks that establish decision rights, validate indicators, allow deliberation and align financial decisions with the

mission of the institution. Without these structures, data-driven tools might increase administrative control without improving performance.

his paper has practical implications: Universities should improve budget transparency, board oversight, data governance, institutionalize academic participation, use performance indicators, policy makers should build capacity rather than report compliance. Future work should test statements on surveys, case studies, panel data, mixed methods design. Comparisons between countries and types of institutions would be useful given different governance structures and funding structures. Financial sustainability is closely related to governance quality in today's complex and data rich higher education environment. Universities that combine accountable governance, evidenced financial decisions and mission-oriented resource allocation tend to maintain academic quality, improve performance and maintain trust. Data driven governance should not be seen as a technical upgrade but rather as a governance capability.

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Mini Discourses in Classroom Interactions: Do Teacher Educators in North-Western Nigeria Care to Explore these for Students' Oral Competence?

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Abstract
In line with global teaching practices, mini discourse exploration is part of an integrated skills development methodology that addresses deficiencies in students' speaking and grammatical competence. In this qualitative investigation, lesson transcripts of four Nigerian teacher educators from two Colleges of Education in the northwest of the country were sampled. The teachers were video recorded in a naturally occurring classroom setting. The data were transcribed and qualitatively analysed. The findings revealed instances of mini discourses that developed during classroom exchanges between teachers and students. The discourses lend themselves to teacher exploration, which is potentially significant for students' debate and discussion. However, none of the mini discourses was explored or contextualised to provide for students' voices. Instead, the teachers continued to cling to a long-established traditional approach, focusing wholesale on the grammatical content of the lessons. Key to the recommendations is raising teacher awareness of integrative skills development and effective classroom interaction. This study of significance for second language classroom practice.

Keywords: Discourse, Exploration, Implicit, Interaction, Oral Competence, Teacher-Educator

Introduction

There is abundant research on classroom discourse, which provides direction on how to support second language learners' oral fluent language (Dao & Iwashita, 2018; Kayi-Aydar, 2013; Lasala, 2014; Tavil, 2010; Yeh & Lai, 2019; Young, 2015). Such an investigation benefits teachers' classroom practice in providing opportunities for cooperative dialogue to explore implicit oral classroom discourses for students' classroom interaction during lesson delivery. In most instances, however, these opportunities are ignored either as part of teachers' teaching gaps or because discourse exploration is not the teaching target. The dominant topic content preoccupation by teachers leads to a loss of such opportunities for students' meaningful interactions and oral skills development. It seems that most classrooms in second language teaching contexts only recycle content focus in their language teaching, resulting in a relegation of students' face-to-face communication (Chan, 2020; Mpho, 2016).

Review of Related Literature

Classroom discourse refers to teacher and student exchanges which develop in the course of classroom lesson delivery. At different stages of a lesson, teachers engage students and invite their contributions in different aspects of the lesson. This happens at the introductory or presentation stage, during class activities, while practicing new language or at the stage where students are exposed to more challenging activities requiring them to produce some new knowledge (Abdul-Majeed & Muhammad, 2015; Cheng, 2021; Masuram & Sripada, 2020).Discourse, oral or written, is marked by coherence and cohesion devices (Banguis-Bantawig, 2019). Coherence ensures that clauses or sentences are sequenced logically to give a sense of meaning. Cohesion is achieved when the text's elements are cohesive or stick together to create meaning. Cohesion is either lexical or grammatical. For lexical cohesion, two subtypes have been identified. The first is the repetition of words used in the discourse. The second is topic-related words, called registers employed in a specific field (Rose et al., 2018). Grammatical cohesion includes the use of anaphoric reference, the use of pronouns. It includes tense agreement, use of linkers and the use of ellipses (Banguis-Bantawig, 2019). The use of substitution is also an element of grammatical cohesion. Substitution in the use of phrases to refer back to something introduced or said in the discourse (Banguis-Bantawig, 2019).

Then, there is a tense agreement. This is marked by the use of right tenses in the discourse to make it meaningful. There is the use of linkers such as, and, but, also, however, and other related words to connect ideas and clauses so that there is a successful, meaningful expression of the message. Grammatical cohesion also includes the use of ellipses in oral interaction. Ellipses mean the deliberate omission of words without the loss of meaning (González & Skultety, 2018). 1.

Written discourse is created around a topic often marked by different types of sentence patterns and, in some instances, involving complex vocabulary. It includes paragraphing with headings and sub-headings, particularly when the topic reflects a formal genre. In general, there can be variation in language and sentence types where the discourse addresses the requirement of an informal genre. Spoken discourse is generally characterised by informality, short utterances, fillers, discourse markers, turn-taking and co-constructed grammar (Bygate, 1987; Masuram & Sripada, 2020). Both types of discourse share in context and appropriate sociolinguistics. They also share in the use of coherence and cohesion devices signalling order and unity in either discourse forms. Students' written and spoken discourses are improved upon through grammar instruction in most second language contexts. It is believed that a good grasp on grammar can support students' written and spoken construction. Spoken skill development particularly requires speaking opportunities in the class so students can employ a variety of grammar for self-expression. This is only possible in integrated skills lessons (Tom-Lawyer, 2016; Wildeman et al., 2021) in which teachers explore and contextualise grammar to provide space for students' oral discourse during classroom interaction.

Research Questions

The main objectives of the Study were to investigate mini-discussions which emerge in the course of teacher-student interactions and how they are explored by teachers to support students' spoken language. In more specific terms, the study aimed to answer these questions.

Research Questions

1. Are implicit min-discourses identifiable in teacher-student classroom exchanges?
2. Did teacher educators explore the implicit discourses for students' speaking fluency?

Accordingly, these research objectives are to find out:

1. If implicit min-discourses are identifiable in teacher-student classroom exchanges
2. Whether teacher educators explored the implicit discourses for students' speaking fluency.

Methodology

This is a qualitative research design which collected and analysed data qualitatively (Salminen et al., 2021; Yuvayapan, 2019). In this study, four teacher educators were selected. Transcripts of their lesson interactions were used for samples of implicit mini discourses. As an instrument for data collection, video recording was employed to record naturally occurring classroom interaction. This was then transcribed and qualitatively analysed to determine mini-discourses that emerge from the interaction and extent of exploring them for students' oral competence.

This investigation is underpinned by sociocultural theory (Vygotsky, 1978), which holds that social interaction is key to scaffolding (Bruner, 1976) students' communicative competence. The classroom provides the sociocultural environment for supporting this engagement. The teacher, as the better other, is the provider of the support mechanism aiming at students' oral discourse competence in the course of teacher-student interactions.

Analysis

The analysed data show that different implicit mini discourses were identified in the patterns of the recorded classroom interactions. The pieces of evidence of the mini discourses were found in the extracts of four teacher educators involved in the study. This is shown in the analysis below:

Teacher educator 1

Teacher educator, asking how much had been covered in the previous lesson, elicited:

T: How many things have we done so far?

St: we have done the identification of phrase, we also have done clause examples, we have done phrase, we also done clause example.

Evidence of Mini-discourse

The teacher educator asked about the topics covered in the previous lesson. A student responded that: "we have done identification of phrase (1), we also have done clause examples (2), we have done phrase (3), we also done clause example." (4). Four clauses were produced. In this mini discourse, there is coherence in the logical sequencing of the four clauses. "We have" is repeated throughout the discourse to explain what was covered as part of discourse cohesion. Other cohesion devices include the grammatical linker "also" in the second and fourth clauses. There is another cohesion in the form of the present perfect "we have done" in all four clauses, making the discourse elements stick together.

This mini discourse can be explored by contextualising it, for example, seeking more elaboration on the phrases and clauses taught and their significance to the students' language use. This could extend to more discussion, allowing students to say more. However, the students missed that opportunity as implied in the teacher's follow-up remark signalling a focus on grammatical elements taught.

T: Very good, so we have almost done that.
(line 11- 15)

The teacher could use other question types such as why, how, for what reasons to reformulate his elicitations. This would provide spaces for students' voices.

Teacher educator 2
In his interaction, the teacher educator said:

T: Suppose the police arrested you late evening or late night. If they arrest you, they will interrogate you, then what do we mean by interrogative? Here, the teacher who produced the mini discourse.

Evidence of discourse devices in this is noticeable in its coherence, marked by a good succession of the four clauses making up the discourse: "suppose the police arrested you late evening or late night (1). If they arrest you (2), they will interrogate you (3), then what do we mean by interrogative?" (4). Then, three types of grammatical cohesion are identified here. The first is the use of the anaphoric reference "they" in the second clause, which refers to the police in the first clause. The second grammatical cohesion is in the linkers "if" in the second and last clause, and "then" in the third clause. The third grammatical cohesion is in the use of tenses: past simple, present simple, future simple, present simple interrogative. So, the tenses mark discourse of the discourse (line 41 – 44).

This exchange equally lends itself to further elicitation, away from modelling 'interrogative' sentences or questions. Was this explored? Certainly not. Asking students to explain the situation of one under police custody can generate meaningful classroom talk, debate and argument. But this was not the focus of interactions. The attention was on 'interrogatives, sentences that ask questions. Question such as what happens when someone is in police custody, was not asked.

The third teacher educator produced a mini discourse while giving examples of sentence types.

T…'Shua ibu came late for the lecture but the teacher allowed him after he considered his case as genuine (line 116-120).

In this discourse, there are three clauses "Shuaibu came late for lecture (1) but the teacher allowed him (2) after he considered his case as genuine." (3) The three clauses cohere meaningfully; they are well ordered. The cohesive elements or devices include grammatical linkers "but" and "after" to connect the second and the third clauses. There is a substitution where "case" substitutes "late" or lateness mentioned earlier in the first clause. There is an anaphoric reference "him" which refers back to Shuaibu in the first clause. There is another grammatical cohesion in the past simple tense use in all three clauses. Then, there is lexical cohesion in the use of interrelated words, "lecture, teacher, late, allowed, case, genuine" that are key registers in the discourse.

As previously examined in previous mini discourses, the teacher, in this instance, did not elicit students' responses on potential reasons why Shuaibu or anyone can come to lectures late. This could lead to varied opinions and responses from the students. The resultant discussion would present opportunities for students' language. But instead, the teacher asked:

…who can tell us the first independent clause?

Again, focus on the grammar elements was prioritised over students' speaking opportunities.

Teacher educator 3

For the third teacher, the discourse arose from a student's response to the teacher's questioning:

T: We are looking for an example of a compound-complex sentence

Student: Sir, 'the boy is crying while the mother is cooking what the husband gave her.

Evidence of discourse devices is in the coherence of the three well sequenced clauses, "sir, 'the boy is crying (1) while the mother is cooking (3) what the husband gave her." There is a logical and meaningful connection between the first, second, and third clauses. Then, there are four types of grammatical cohesion elements involving linkers, "while" and "what" in the second and third clauses. Another grammatical cohesion is identified in substituting "gave her" with "what" in the third clause. There is also grammatical cohesion in the form of the anaphoric reference "her" which refers to the mother in the second clause. Noticeable still is grammatical cohesion in the use of tenses: present continuous in the first and second clauses, past simple in the third clause. In the final instance, there is lexical cohesion where interrelated words "boy, crying, cooking, father" are used as home management topic-specific words. This makes the text stick together.

A three-clause sentence formed a meaningful mini discourse around a theme comprising mother, husband and a crying baby. If this discourse were put in the context of an extended discussion, students could interact lively on husbands struggling to make food available for the family; they could talk on the role of wives in home management. Away from that, the teacher concentrated on compound-complex sentence examples. Meaningful, oral interaction opportunities were lost.

Teacher educator 4

This teacher presents two instances of mini discourse in the course of classroom dialogue. The first implicit discourse was built around the Nigerian team. This emerged while the teacher was modelling dependent and independent clauses.

T: The Nigerian team won the World Cup when it was hosted by Korea and Japan (line 41)

Coherence is achieved in the two clauses through the logical ordering of the clauses. There is grammatical cohesion in the use of the linker "when" connecting the first and second clauses. There is also another grammatical cohesion to do with anaphoric

reference “it” that refers to “World Cup” in the first clause. There is another grammatical cohesion in the use of the simple past tense in both clauses. Lexical cohesion is noticed in the use of soccer-specific register “team, won, World Cup, hosted, Korea, Japan.”

Soccer, particularly in Nigeria and elsewhere, is a key and popular sport and therefore a recipe for students’ lively oral discussion. It provided a theme for rich and interesting debate for students’ varied responses. But that did not happen. Not realising any value for students’ oral language, the teacher invested his teaching energies in teaching dependent and independent clause types.

The second mini discourse also emerged from teacher modelling of compound sentences, on the theme of staff promotion in the civil service.
“Shehu was promoted because he was hard-working” (line 66).

In similar ways, there is coherence in the logical order of the two clauses: “Shehu was promoted (1) because he was hardworking.” (2). In this clause, grammatical cohesion is noticed in the linker “because” connecting the two clauses. There is an anaphoric reference “he”, a reference back to “Shehu” in the first clause. Another grammatical cohesion is noticed in the tense construction, showing past simple for the clause and past continuous tense for the second clause, respectively. Then of course there is lexical cohesion in the use of interrelated words “promoted, hardworking,” around which the theme of the discourse.

One of the ways to engage students in speaking is through modelling or giving examples to students. The second teacher used modelling to guide students’ learning of a grammatical concept, “Suppose the police arrested you late evening or late night. If they arrest you, they will interrogate you, then what do we mean by interrogative? Teacher examples, once contextualised, can provide rich student responses (Gillies, 2015; Jones & Chen, 2016; McNeil, 2011). Because in this context, other open questionings can lead students to talk about police arrests, questioning and other ordeals that suspects suffer in detention.

The third teacher trainer also employed modelling. Shuaibu came late for the lecture, but the teacher allowed him after he considered his case as genuine (line 116-120), which was limited to practising the function of dependent and independent clauses. This example was set in a context of Suaibu, a late-comer to lecture and provides an opportunity to go beyond the grammar to explore issues leading to students coming to lecture late, beyond a structural content focus.

The fourth teacher eliciting example of a compound complex sentence led to a student’s response, ‘sir, ‘the boy is crying while the mother is cooking what the husband gave her’. (line 76 – 77). This can extend to longer discourse to offer students speaking opportunities. But again, such opportunities were lost to prioritise traditional grammar teaching practices. Similarly, exploring talk on Nigerian football, which was the topic content of the implicit discourse, did not happen. In all these instances, the different implicit discourses emerging from teacher-student interactions could all be explored and contextualised to provide chances where students, in addition to learning grammatical elements, improve their spoken language competence. Integrated skills development methodology (Harmer, 2007; Idrissova et al., 2015; Tuan, 2017) provides for supporting students’ different language skills in a single lesson. Thus, focus on language structures

and mini discourses could be focused on, with the discourses contextualised to generate discussions.

Studies on contextualised teaching practices show immense benefits to students' language learning and language competence if well handled by teachers (Lo & Jeong, 2018; Mayo & Barrioluengo, 2017). Teaching grammar and oral discourse is well captured under integrated skill development (Banegas et al., 2020; Heppt et al., 2022; Onwe & Uwaleke, 2019). Thus, while instruction centres on grammar, students' voices can be allowed to initiate, contribute or elaborate classroom discussions with teachers' scaffolding. In an investigation, Tuan (2017) revealed that students' linguistic and discourse competence is supported by formal instruction and teacher-initiated conversations.

The discourses were implicit because their emergence resulted from interactional circumstances; they were not the teaching target, even as it was apparent that students' oral fluency was lacking. Teacher questioning provides a good channel for oral communication. This was employed by one of the teachers, "What have we done so far?". The response by one of the students, "we have done identification of phrase, we also have done clause examples, we have done phrase, we also have done clause examples" (line 11-13) is open to further questioning and elicitations for extended classroom talk. But this did not happen because the grammatical elements done, shown in the students' response, were the main preoccupation of the teacher. Even the type of question asked was a closed one, requiring no extended talk. Whereas teacher questioning, if well employed, has been proven to be efficient in checking and involving students' voices in the classroom (Coyle & Roca de Larios, 2020; Studhalter et al., 2021).

Findings and Discussion

In all the instances, mini discourses have been identified and analysed in the classroom interactions of the four teacher educators with supporting evidence from each of the discourses. Elements of coherence and cohesion were identified in all the mini-discourses. This answers research question one: Are min-discourses identifiable in teacher-student classroom exchanges?

And, from the evidence-based analysis, it is clear that none of the teachers explored the mini discourses for any meaningful oral classroom talk. The attention was wholly on the grammatical elements in the discourses. The teaching focus was on the identification of phrases, interrogative sentences, compound-complex sentences and dependent and independent sentences. The teacher educators, therefore, did not explore these interesting mini discourses for students' speaking fluency. This answers the second research question, asking: Did teacher educators explore the implicit discourses for students' speaking fluency?

Conclusion

In almost all language instruction, as analysed in this study, instances of implicit mini-discourse occur in lesson delivery. They are mini because they comprise only a few clauses or sentences; they are also implicit because they are not easily noticeable since they are not the teaching target. However, if explored, they would provide ample spaces for students' voices and contribute to their oral discourse competence. The findings in this investigation show that implicit mini discourses are not recognised and explored by teachers, while all attention is spent on grammatical focus and structural language teaching.

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Integrating Digital Innovation and Culturally Relevant Pedagogy for Global Competence in Sustainable Education

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Abstract

Education is a process that cultivates a wider outlook and discernment, propelling critical and creative thought processes. The seeds sown in young minds take root, and their perspectives are shaped by what they learn. At times, the acquisition of knowledge and practical wisdom through education is confined to the curriculum, often ignoring or giving less importance to one's roots. The current research focuses on incorporating Place-based Education as a pedagogical approach to shape students' mindsets locally and then globally. Such an approach is the need of the hour, as the student community must cultivate a deeper connection with and responsibility for their environment, community, and culture. Gloria Ladson-Billings' Culturally Relevant Pedagogy serves as the theoretical framework for this analysis. She cites Cornel Pewewardy's assertion that one of the reasons Indian children experience difficulty in schools is that educators have traditionally attempted to insert culture into education, instead of inserting education into culture. This statement is also relevant to the field of higher education. Glocalization becomes meaningful only through the implementation of such culturally relevant pedagogies. Thus, integrating local contexts and global resources can foster meaningful and globally aware learning experiences. Furthermore, emerging digital modes provide new platforms for reinforcing local knowledge in innovative forms, while staying aligned with global needs. The study attempts to integrate culturally relevant pedagogy with modular learning structures to foster sustainable education. By aligning localized knowledge with modular flexibility, this framework proposes a resilient educational ecosystem in which facilitators utilize self-contained learning modules to build students' global competence while mirroring the community's cultural wisdom.

Keywords: Culturally Relevant Pedagogy, Digital Tools, Global Competence, Glocalization, Modularity, Place-Based Education

Introduction

Education is a transformative journey that promotes knowledge acquisition and chisels the thought process in order to attain practical wisdom. It has been imparted through innumerable pedagogies that train the learners to acquire academic and life skills. It is considered a holistic process, not limited to academic and professional success, but rather extends to moulding an individual into a responsible, ethical, and socially conscious human being. It makes one aware of one's position at the giving end, contributing to the betterment of humanity and society. Today's scenario poses a pertinent question: whether the true purpose of education is really being attained or if it is merely being used as a tool

for attaining economic success. A learner tends to look at the curriculum as an external component that would decide their future and least bothers about its inherent knowledge and value system. This is largely because of the inadequacy of the prescribed text or pedagogies employed. When the learning material or pedagogy does not reflect the cultural ethos of the learner, the learning process and the learner seem to be disconnected entities. In addition, the digital era has not only resulted in information overload but also fostered a culture of distraction, as a result of which the learner community struggles to wade through it. At the same time, appropriate use of technology in the teaching-learning process will not only promote learners' understanding but also pave the way for enhancing their critical and creative acumen.

Place-based education is a pedagogical approach that prioritises "experiential, community-based, and contextual/ecological learning to cultivate greater connectivity to local contexts, cultures and environments" (Yemini). Gloria Ladson-Billings's theory of Culturally Relevant Pedagogy, with the case studies supporting it, proves to be fruitful in the contemporary context, aided by digital tools. Such an attempt will facilitate the learners to acquire global competence, with a strong footing in their cultural knowledge. Thus, sustainable education can be achieved through the wise amalgamation of Culturally Relevant Pedagogy and Digital Tools, leading to Global Competence.

Review of Related Literature

The application of Gloria Ladson-Billings's theory of Culturally Relevant Pedagogy has been dealt with in many articles. To cite a few, Mrinal Mukherjee, in her article "Culturally Responsive Teaching Learning in Indian Multicultural Context: Review of Contemporary Policy & Practice," explores the cross-cultural instructional challenges and reviews culturally responsive teaching learning at the school education level. Similarly, Dr. Atal Bihari Tripathy and Mrs. Subhashree Mishra attempted a qualitative case study in the "Role of Culturally Responsive Teaching in Advancing Equity and Engagement in Diverse Classrooms," conducted in government and private secondary schools across urban and semi-urban areas of Dehradun district. The author of the article, "Rethinking Multicultural Education beyond Cultural Celebrations: Pedagogical Barriers in Indian Schools," Priti Sangray, underscores the importance of integrating multicultural education in schools.

While such articles underscore the importance of Culturally Relevant Pedagogy at the school level, there remains a noticeable gap in research concerning its application within Higher Education contexts. The present study seeks to address this gap by examining the implementation of Culturally Relevant Pedagogy in Higher Education through the integration of digital tools and technology-enabled pedagogical practices. By exploring how digital platforms can support culturally responsive teaching and enhance student engagement, inclusivity, and academic participation among diverse learners, this research contributes to extending the scope of Culturally Relevant Pedagogy beyond school education and into contemporary higher learning environments.

Objectives

The objective of the current study is to highlight the significance of culturally relevant pedagogy facilitated through digital tools in higher education, as it provides opportunities for acquiring global competence and thereby promotes sustainable education. Such an approach can make learning more meaningful, relatable, and engaging for students from

diverse backgrounds. It also aims to bridge the gap between traditional values and modern educational practices, thereby fostering holistic development among learners.

Methodology

The study proposes a pedagogical methodology that amalgamates Culturally Relevant Pedagogy and the 'Modularity' principle of Adaptive Design for Learning to promote sustainable education. The approach facilitates learners' conceptual understanding through local cultural contexts while fostering global thinking, adaptability, and global competence.

"Educational practices must match with the children's culture in ways which ensure the generation of academically important behaviors" (Jordan, 1985, p.110). Students are inherently multi-faceted individuals whose learning is shaped by their diverse cultural, social, and linguistic backgrounds. Their lived experiences and identities often differ significantly from the perspectives represented in prescribed textbooks, which may reflect contexts that are unfamiliar or culturally distant. As a result, learners may find it challenging to fully connect with or relate to the content when it does not align with their cultural realities. This highlights the importance of instructional approaches that acknowledge students' cultural rootedness and bridge the gap between formal academic content and their everyday experiences.

Gloria Ladson-Billings, in the article "But That's Just Good Teaching! The Case for Culturally Relevant Pedagogy" (1995a), has attempted to locate the problem of discontinuity between what students experience at home and what they experience at school in the speech and language interactions of teachers and students. These sociolinguists have suggested that if students' home language is incorporated into the classroom, students are more likely to experience academic success. Villegas (1988), however, has argued that these micro-ethnographic studies fail to deal adequately with the macro social context in which student failure takes place. (pp.159-160)

Ladson-Billings further observes that successful teaching comprises the first step of deciding what to do with regard to the social context, the students, the curriculum, and the methodology. According to her, the teachers engaged in culturally relevant pedagogy must be able to deconstruct, construct, and reconstruct the curriculum. Deconstruction refers to the ability to take apart the "official knowledge" to expose its weaknesses, myths, distortions, and omissions. Construction refers to the ability to build curriculum… Reconstruction requires the work of rebuilding the curriculum that was previously taken apart and examined. (2006, p.32)

Teachers in higher education in India, especially those working in private universities and autonomous colleges, can consider redesigning their curriculum to reflect both global and local (glocal) needs. At the same time, educators who use prescribed textbooks can adopt instructional strategies to develop cultural competence among students. A teacher can build cultural competence by linking textbook concepts to learners' lived experiences within their local context. For example, while teaching a lesson on environmental conservation, a teacher in India can connect the concept to traditional practices such as rainwater harvesting in rural Tamil Nadu or the community-driven water management systems seen in villages. By relating the textbook idea of sustainability to practices like maintaining temple tanks (ooranis) or local farming methods that depend on monsoon cycles, the teacher helps students see that the concept is not abstract but already present

in their cultural environment. This approach makes learning more meaningful and rooted in students' everyday realities. Ladson-Billings observes thus: "My sense of cultural competence refers to helping students to recognize and honour their own cultural beliefs and practices while acquiring access to the wider culture, where they are likely to have a chance of improving their socioeconomic status and making informed decisions about the lives they wish to lead" (2006, p.36).

Analysis

Cultural competence enables students to remain grounded in their own cultural beliefs and practices while effectively engaging with broader global perspectives. This balanced identity allows them to navigate diverse academic, social, and professional environments with confidence and adaptability. As a result, culturally competent students are better equipped to communicate across cultures, collaborate in international settings, and make informed life choices. By valuing their own cultural roots alongside global knowledge systems, they develop the flexibility and awareness needed to excel in a globalized world. Thus, Ladson-Billings, in "Toward a theory of culturally relevant pedagogy," argues that culturally relevant pedagogy helps students succeed in school while still valuing and preserving their own culture. In the example, a teacher used rap lyrics to teach poetry concepts, then connected those lessons to traditional poetry. Students who were good at writing or improvising rap were encouraged and recognized for their skills. (1995b, p. 476).

Although culturally relevant pedagogy has often been discussed in relation to school education, it is equally significant in the context of higher education, particularly in today's digital era. In India, many students from rural backgrounds enter colleges and universities with strong aspirations for social mobility and economic advancement. However, they frequently encounter challenges such as linguistic barriers, differences in cultural capital, lack of confidence, and unfamiliarity with urban or digitally driven academic environments. In such contexts, culturally relevant pedagogy can play a transformative role by connecting classroom learning with students' lived experiences, local knowledge systems, languages, and cultural practices. When educators acknowledge and incorporate these backgrounds into teaching practices, students are more likely to feel valued, confident, and motivated to participate actively in classroom discussions and academic activities. This approach not only supports academic achievement but also creates inclusive learning spaces where rural students can express themselves freely without feeling alienated or inferior.

Online learning and digital tools play a significant role in enhancing teaching and learning. In order to develop culturally competent students, teachers should design learning modules that integrate three key dimensions: knowledge, culture, and global relevance. Such modules should first provide clear conceptual understanding of the content (knowledge), then connect it to learners' lived cultural experiences to make learning meaningful (culture), and finally extend the discussion to a broader global context to highlight its wider applications and implications.

By following this approach, students are able to see learning as both locally rooted and globally relevant. Digital tools can further support this process by offering multimedia resources, interactive tasks, and collaborative platforms that encourage engagement with diverse perspectives. This not only strengthens conceptual clarity but also helps learners develop critical thinking, cultural awareness, and global competence. Ultimately, such an

instructional design prepares students to navigate and contribute effectively in an interconnected world.

In this VUCA (volatile, uncertain, complex, and ambiguous) world, teachers need to continuously revisit and reimagine their pedagogical approaches to remain relevant and effective. Integrating technology into teaching and learning becomes essential, not only to enhance accessibility and engagement but also to provide learners with diverse and real-world exposures.

Adaptive Design for Learning (ADL) is a framework for designing online modules or courses that supports educators in reflecting on and improving course design. It is offered grounded in strong pedagogical principles and is intended to address learners' VUCA contexts. The framework is based on five key principles: adaptability, active and interactive learning, the 3Cs of online learning, the balance of asynchronous and synchronous learning, and modularity. (Ateneo SALT Institute, 2025, Module 1)

A common issue in traditional teaching is the tendency to deliver instruction first and conduct assessment only at the end of a course. This approach often delays meaningful feedback, leaving learners unaware of their progress until the course is nearly completed. To address this, Adaptive Design for Learning encourages a shift toward a modular structure. In this approach, courses are divided into smaller, self-contained units that are both meaningful and flexible. These modules can be combined to form a complete course or used independently for workshops or focused learning sessions (Ateneo SALT Institute, 2025, Module 1.8). Designing learning in modular form also creates natural checkpoints throughout the course. This enables continuous assessment and more frequent feedback, allowing both instructors and learners to monitor progress and make timely improvements.

While the desired learning outcome is the acquisition of knowledge and skills, with holistic attitudes, the most important feature is the application of the acquired knowledge, skills and attitudes which ADL refers to as "comptences" (Ateneo SALT Institute, 2025, Module 2.2). According to the ADL course, "A competence is what we hope our students would acquire at the completion of a course so that they can use the knowledge, skills, and attitudes that they have learned beyond the classroom" (2025, Module 2.2). For example, in a course "Gender Studies," the objective of the course teacher is to adopt a pedagogy that will inculcate cultural and global competence in the students by acquiring

- Knowledge of gender issues in local and global contexts, and an understanding of how each person's identity is shaped by gender-based perspectives.
- Skills in evaluating, analyzing, and rethinking gender-specific roles, both locally and globally.
- An inclusive attitude that embraces all people, including those identified as LGBTQIA2S+, under the universal fold of humanity.

In contrast to focusing on taught/ contact time, a focus on Learning Time will help students acquire the competences, quite naturally and practically. Learning time does not distinguish between synchronous and asynchronous learning, but rather centres on the process of learning, including activities such as assignments, discussions, debates, and pre-reading tasks. The concept of Learning Time is a dynamic shift towards enhancing student competences. The challenge ahead for designing a course based on Learning Time

will be creating modules that accommodate different learning activities that both spark their interest and nurture the required competences.

For example, in a course “Basic Communicative English,” Learning Time should be realistic, and it should engage students in a variety of activities that develop their LSRW (Listening, Speaking, Reading, and Writing) skills through literary and authentic texts reflecting varied cultural experiences. One of the intended competences is the ability to use English appropriately and confidently for general and specific purposes, with an awareness of intercultural communication, cultural nuances, and context-sensitive language use. A key challenge in online learning is maintaining learner engagement. ADL course advocates four key strategies to optimize learner engagement. First strategy is to design content in small, manageable “bite-sized” (Ateneo SALT Institute, 2025, Module 4.3) chunks. Since attention and working memory are limited, breaking content into segments helps learners process and retain information more effectively.

Another strategy is the use of clear signalling techniques. This involves guiding learners by highlighting key ideas before, during, or after presenting content. Providing guiding questions, summaries, or simple explanations helps learners focus on the most important concepts and reduces cognitive overload.

Effective online learning also benefits from combining audio and visual elements in a meaningful way. Visuals should support and clarify the content rather than repeat text unnecessarily. Well-designed multimedia presentations enhance understanding by integrating words and images purposefully. According to Cognitive Theory of Multimedia Learning, learners process information through both visual and auditory channels when engaging with multimedia content (Mayer, 2003). Learning becomes more effective when these two channels are well integrated and work in a coordinated manner. Finally, content design should encourage deeper engagement with ideas. Instead of passive consumption, learners should be given opportunities to discuss, critique, annotate, or investigate content. Activities such as collaborative reading, discussion tasks, or inquiry-based learning help learners move beyond surface understanding to deeper analysis and reflection.

The key strategies for module preparation techniques, as per Ateneo SALT Institute (2025), include the following:
Segmenting: The duration of the module can be fifteen minutes at the most. In case of lengthy content, it should be divided into meaningful segments that elaborate on one or two central ideas. It should provide a brief overview of the key terms in the lesson, along with appropriate explanations and reflective questions. This serves as a foundation for students’ understanding of the subject and its relevance in the local and contemporary world. The way the video unfolds allows students to listen, pause, and reflect on the concepts, facilitating deeper understanding.

Pre-training: The video, at the outset, should pre-train the students with regard to the significance of the content, relevance of the topic, with a practical example, and presentation of a brief overview of the content

Signalling: The module should make potential use of signalling at various places in order to emphasize the meaning and context of the terminology. For example: pictorial representations, highlighting, using bullet points, incorporating graphs, a clear breakdown

of acronyms, listing, usage of colours, questions and prompts, and summarizing key takeaways. Signalling by contrast includes listing and other illustrations that help students clearly distinguish the concepts.

Concretizing: One effective way to make content more accessible to students is by making it concrete through examples, stories, and metaphors. Using examples connected to students' prior knowledge and cultural experiences helps students understand new ideas easily. Instead of teaching concepts in a purely abstract manner, teachers can relate them to familiar literary texts, traditions, or social contexts. For example, when teaching percentages, a teacher in Tamil Nadu might use examples from local shopping practices, such as festival discounts during Pongal sales, instead of using unfamiliar foreign contexts. This helps students connect mathematical concepts to their everyday experiences.

Similarly, while teaching the socio-cultural significance of agricultural symbols, a teacher might compare the West African (Igbo) concept of the Yam with Paddy (Nel) from the Tamil agrarian tradition. Students who are already familiar with how newly harvested rice (Pudhu Nel) dictates family status, masculinity, and ritual offerings during Thai Pongal may better understand why the Igbo community elevates the Yam as the "king crop" (National Root Crops Research Institute, n.d.).

In both societies, these crops are not just food; they are sacred symbols of wealth, hard work, and blessings from ancestors. In Igbo culture, a man's worth and ability to marry are judged by the size of his yam barn, which perfectly mirrors how historical Tamil families were respected based on the size of their paddy granaries (Nel Kalanjiyam). Relating an unfamiliar global crop to a culturally familiar staple helps students see that distant cultures share the very same values as their own. This simple comparison bridges the geographic gap, making foreign traditions easy to grasp while deeply increasing classroom comprehension and student engagement. The technique of familiar analogy while introducing new concepts will capture immediate attention and arouse curiosity among students. While teaching imagery in literature, a teacher can use a culturally familiar analogy like this: Imagery in a story is like the detailed descriptions in a traditional Tamil folk performance or a temple festival procession. Just as people can almost 'see' the brightly decorated chariot, 'hear' the nadaswaram music, and 'smell' the camphor and flowers during a temple theru thiruvizha, imagery in literature uses words to create vivid sensory experiences in the reader's mind.

Audio Visual: Audio-visual tools make learning more meaningful by connecting ideas to what students can see and hear in their everyday cultural surroundings. Essential processing of the content should be made possible with illustrations or other techniques that ensure learners actively process and retain the key concepts. A visual representation simplifies abstract ideas, making the learning experience more meaningful. Moreover, the combination of narration and imagery ensures that learners actively process and retain the key concepts presented. Similarly, there should not be any extraneous elements such as visual redundancy, distractions and extraneous cognitive overload.

Diving Deep into the Content: The module should employ multiple strategies to engage students deeply with the content, including interactive questions and prompts for discussion. At every significant point in the presentation, the presenter should introduce learners to various dimensions of the topic through existing knowledge frameworks. This

approach allows learners to follow the lecture smoothly, minimizing cognitive obstacles and enhancing comprehension.

Findings and Discussion

Towards the end of the presentation, a discussion forum can be facilitated to stimulate students' critical thinking on the topic. Discussion points are to be introduced sequentially rather than all at once. Pauses should be provided between points, along with hints that prompt reflection. This step-by-step approach will encourage active participation and deeper engagement with the content. By offering clues instead of direct answers, independent reasoning is supported. The discussion forum also promotes peer interaction, enabling students to consider multiple perspectives before arriving at their conclusions.

To summarize, the module should be a systematically designed audio-visual tool that introduces key concepts through interactive and thought-provoking techniques grounded in culturally relevant pedagogy. Utilizing culturally familiar visuals and local, real-life examples helps students validate their indigenous identities while connecting new, global ideas to their existing prior knowledge. Simultaneously, the presenter's interactive tone and guided discussion foster an active learning environment that respects diverse learner backgrounds. Strategic use of slides and visuals will avoid cognitive redundancy, emphasize essential concepts, and encourage reflective thinking on the central theme. Finally, the concluding discussion forum acts as a critical space for students to engage in peer dialogue, evaluate multiple socio-cultural perspectives, and develop independent reasoning, thereby translating their localized learning into a broader global consciousness.

The study indicates that the integration of culturally relevant pedagogy with digital tools significantly enhances the effectiveness of higher education learning environments. When online modules are designed by teachers in alignment with learners' cultural contexts, students demonstrate higher levels of engagement, comprehension, and motivation. Culturally contextualised content enables learners to connect theoretical knowledge with lived experiences, thereby improving conceptual clarity and retention. The use of teacher-created digital modules allows for flexibility in content delivery and supports differentiated learning needs. Learners benefit from multimodal resources such as videos, interactive tasks, and culturally embedded examples, which promote active learning and sustained attention. Furthermore, the findings suggest that culturally responsive digital instruction fosters inclusivity by acknowledging diverse learner identities and experiences within the classroom.

It is also observed that such pedagogical practices contribute to the development of global competence. By grounding local cultural perspectives within broader academic frameworks, students are better able to engage with global issues critically and reflectively. This balance between local relevance and global awareness exemplifies globalization, driving sustainable education within higher education contexts.

Conclusion

The study concludes that sustainable education in higher education can be effectively achieved through the convergence of culturally relevant pedagogy and digital learning environments. Online modules designed by educators, when aligned with the cultural and cognitive needs of learners, create meaningful and engaging learning experiences.

Such an approach not only enhances academic achievement but also fosters inclusivity, critical thinking, and global competence among learners. Therefore, the purposeful integration of cultural context into digital instructional design emerges as a key requirement for transforming higher education. This model supports a shift towards learner-centred, responsive, and sustainable educational practices that are essential in an increasingly digital and interconnected world.

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The Role of Ready-Made Digital Curricula in Enhancing Primary Schools' Response to Educational Crises in the Nablus Governorate

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Abstract

The In light of the continuing exceptional circumstances in Palestine and the political and economic instability affecting all sectors, particularly education, this study examines the recurring disruptions to the educational process and the resulting increase in students' learning loss. It focuses on one strategic solution: the use of ready-made digital curricula delivered through educational platforms. The study adopted a descriptive-analytical approach to explore the role of these curricula in supporting educational continuity. The findings revealed the necessity of addressing repeated educational disruptions—which vary across Palestinian regions according to political conditions—through proactive planning rather than reactive responses. Statistical analysis showed that ready-made digital curricula significantly enhance the ability of primary schools in Nablus Governorate to respond to educational crises, compensate for lost learning, and provide a reliable alternative to conventional e-learning in many situations. Based on the findings, the study recommends strengthening the integration of ready-made digital curricula in schools, especially at the elementary level, and establishing an enabling environment for officially adopting digital learning platforms across all subjects. It also recommends supporting private educational platforms, training parents to use these systems effectively, and developing technical solutions that reduce dependence on internet connectivity.

Keywords: Artificial Intelligence, Digital Curricula, Educational Crises, Elementary Schools, Nablus

Introduction

Sustainable Caught between the hammer of occupation and the successive financial crises the Palestinian Authority has faced for years—accompanied by repeated strikes in its most critical sectors, health and education—and the region's three-year history of war and political instability, education in Palestine is facing its most perilous phase in decades, especially since this situation followed the COVID-19 pandemic, which exacerbated educational gaps and hindered the learning process, not to mention the near-total collapse of the educational system in the Gaza Strip following the recent war.

However, the rapid developments the world is witnessing in technology and digitalization have had the greatest impact on efforts to save the education sector under these circumstances by enhancing learning methods and improving the educational process.

This is what (Dawla,2026) pointed out in his article on distance learning in Palestine: from an emergency solution to a strategic decision. Given the instability the region is experiencing, it appears that distance learning is no longer a secondary option, but rather a strategic necessity in which investment is required. However, its success depends on the seriousness with which it is transformed from a temporary solution into a comprehensive educational system based on planning, governance, and quality.

Since education is considered a matter of national security, educational policy in Palestine is managed by the Ministry of Education, which is responsible for school education. The Ministry of Education leads national efforts for strategic educational planning, in collaboration with government agencies, civil society organizations, and official institutions. (Al-Saoud, 2024)

However, education in Palestine faces many challenges, as noted in the study " . Among these challenges are the inconsistency of policies at the top of the educational hierarchy and the absence of a coherent, evolving educational philosophy with an institutional character, as many policies are tied to the person of the Minister of Education, which has prevented their relative stability and created a gap between educational reform efforts within the educational system and the educational field, which is burdened by numerous challenges, burdens, and obstacles. For its part, the Ministry of Education has highlighted a number of obstacles, the most significant of which are the occupation and its repercussions, the political division between the West Bank and the Gaza Strip, students' poor performance on international tests, the rise in violence in schools, the adoption of a teacher- and curriculum-cantered educational model, and the inability to provide adequate school buildings. (Ministry of Education, 2021)

Within the Strategy for Education and Higher Education to Develop Education in Palestine 2025–2027, the report noted that risks related to mobility, movement, access, and enrolment due to attacks by the occupation and its settlers are among the most significant obstacles to student and teacher enrolment and access. (Ministry of Education and Higher Education, 2025)

Review of Related Literature

As for education in Gaza, it faces another set of complex challenges that require concerted efforts at all local and international levels, as "the Gaza Strip suffers from difficult economic and political conditions that have negatively impacted education, with the education system facing mounting challenges due to a lack of resources, restrictions on the movement of teachers and students, and severe overcrowding in schools. The recent war marked a dangerous turning point in the educational system, transforming the educational crisis into an existential disaster that threatens the right to education for an entire generation. (And estimates indicate that a large proportion of educational institutions in the Gaza Strip require either complete reconstruction or major repairs. (Jaber and Ali, 2024)

Radical and flexible solutions were therefore necessary to ensure the continuity and quality of the educational process. Drawing on the experiences of other countries and given the rapid pace of technological development, digitization, and artificial intelligence, it was imperative to harness these advancements to save the educational system.

In a study by (Al-Marahla and Al-Zuraikat, 2022), it was noted that there is no doubt that educational technology has made education more accessible to a larger number of students worldwide. Consequently, numerous educational centers have been established that offer—with the aid of technological tools – online or hybrid (blended learning) teaching methods, thereby facilitating access to education. On the one hand, educational technology makes teaching easier by providing new media and channels that teachers can explore to communicate with students, and today, thanks to technology, teachers can assess students more easily and quickly, prepare lessons more efficiently, automatically grade exercises, and monitor each student individually or identify when a student is falling behind.

A study on inclusive education in Palestine in the digital age highlighted the key reasons why the need for digital education extends beyond technology's role in simply improving educational quality; it is also essential for ensuring the continuity of learning under difficult and complex circumstances. Education in Palestine, particularly in Gaza, has faced a severe crisis in recent years, leading to disruptions in schooling and forcing large numbers of children to abandon in-person learning for extended periods. Furthermore, a significant number of schools and educational institutions have been damaged or destroyed, making access to education a daily challenge rather than merely a matter of educational development. In the West Bank as well, education continues under significant economic and institutional pressures, amid financial crises that have affected the ability of educational institutions to operate effectively. Therefore, technology is no longer merely a tool for modernization; it has become an essential part of the educational response needed to support the right to education, reduce educational loss, and provide flexible alternatives that ensure the continuity of learning in fragile environments. (Qarabsah, 2026)

In a study by (Burhan al-Din and Shihadeh, 2025) addressing the digital transformation of education in the Palestinian context, this study was conducted to highlight significant structural and contextual constraints in Palestine, including limited resources, inadequate digital infrastructure, and social and political constraints. Furthermore, the analysis emphasizes the need for comprehensive teacher training and community engagement to mitigate resistance to digital change. By addressing these challenges through targeted interventions and collaborative frameworks, the study proposes practical solutions to foster a comprehensive and flexible digital education system, ultimately paving the way for long-term educational and social development in Palestine. However, the adoption of e-learning and digitization in education is not a magic solution that will overcome face-to-face education and its challenges. There are many challenges that have been and continue to be a fundamental obstacle to establishing a comprehensive educational system that can be relied upon in the educational process to achieve multiple goals, not just during crises.

Here, it is essential to define the concept of crises in education as: any obstacles or challenges within educational institutions or in their surrounding environment that cause a loss of education in aspects related to the quality and regularity of education within educational institutions, and prevent the educational process from continuing on its natural and familiar course (Abu Arar, 2022).

On this topic, Hamad (2021) noted, following a survey of Palestinian mothers regarding distance learning for children in grades 1–4 in the Ramallah area, and found that the

mothers reported “a lack of prior preparation, insufficient technology, ineffective and unengaging e-learning, and a lack of ministerial preparation for such a crisis.” This finding specifically suggests that ready-made digital curricula—pre-prepared and not reliant on teacher improvisation—could have filled a real gap. Shuaib and Adwan (2025) For their part noted that, following their study of the challenges of e-learning during the Israeli aggression, the study recommended adopting flexible educational policies, strengthening digital infrastructure, and intensifying vocational training and psychological support to ensure the continuity of education in emergency situations. Its significance lies in providing a research model that can be applied in educational settings affected by conflicts and disasters.

Teachers also identify other obstacles, including irregular student attendance, student assessment, and online learning. The study highlights the critical success factors for adopting e-learning, as this type of learning requires specific skills and competencies from both teachers and students. Teachers must also adopt diverse teaching methods that take into account individual differences, learning styles, and psychological support. These methods require advanced training before they can be implemented in Palestine. Additional recommendations were made, including promoting an e-learning culture, raising awareness of community partnerships, enriching teacher preparation programs, and conducting training courses for teachers. (Al-Da’is, Sabah, & Abu-Sabah, 2021)

As for the importance of knowledge of digitalization and artificial intelligence programs, which are central to the use of educational platforms, ((Abu Eita, Abbas Ali, and Al-Awadhi, 2025) through their research on the importance of digital literacy, that relevant authorities provide an appropriate environment for digital literacy among secondary school students by developing a strategic plan that begins with preparing students from pre-secondary levels and developing educational curricula that support this, and by preparing and training teaching and administrative staff in schools to begin the practical implementation of digital literacy.' Ghanem (2024) for her part noted in her study, which seeks to address the sustainable curriculum; applications of artificial intelligence in education; and the challenges facing their implementation in the field of education. It is imperative to begin implementing the principle of educational integration between science and technology in all educational curricula, and to apply modern trends in curriculum integration, such as the STEAM educational approach, when planning and designing curricula at all educational levels, It is also necessary to train teachers in colleges of education on curriculum integration, the incorporation of technology into curricula, and the use of digital curricula, as well as to provide in-service training for teachers on the use of artificial intelligence applications and digital transformation processes in teaching and learning.

In a study by (Nadasimia & Nadasimia, 2022) on proposed solutions to reduce barriers to digitization in education, the researchers proposed “a digital solution for elementary schools in conflict zones using the Moodlebox platform to enable these children to learn with the help of teachers and parents.” The methodological approach of our solution relies on the use of a Raspberry Pi 3 B+ device, on which we install the Moodle platform for all elementary school grades. This solution does not require an internet connection or network infrastructure to function, as each student is provided with a tablet that enables them to connect to the digital elementary school platform via Wi-Fi.

It can be said that “distance learning can be more effective and successful if there is rapid planning and implementation by the government, adequate training for teachers in information technology, provision of devices, and internet access, and additional support for low-income families. Therefore, school administrations and policymakers should consider implementing changes that will improve the current state of virtual learning" (Zouki, Musban, & Bezour, 2022).

The application of digital literacy skills in elementary schools is a systematic approach aimed at creating an independent, student-cantered learning environment through the effective and efficient use of digital technology. In a study summarizing the views of elementary school teachers, the teachers emphasized the importance of implementing digital literacy skills due to their impact on the efficiency and effectiveness of school resource utilization, the improvement of educational quality, and their contribution to the development of 21st-century skills. The study concludes that school administrators must manage the curriculum and establish regulations governing the provision of the necessary infrastructure for the implementation of (Prasetyo، Aliyyah, and Widyasari ، 2025)

Objectives

This study aims to examine the role of digital curricula in addressing educational challenges in elementary schools, and whether parents rely on them to mitigate learning loss among elementary school students. Given the exceptional circumstances facing education in Palestine, the study also aims to investigate whether the type of school (public, private, or UNRWA) influences the level of commitment to providing ready-made digital curricula for students.

Given the economic conditions faced by citizens in Palestine, the study aims to identify the impact of the absence or lack of access requirements for digital programs (such as a mobile device, computer, internet, and knowledge of how to access platforms) on the effectiveness of digital programs.

Research Questions

- What is the role of digital curricula in overcoming educational crises in elementary schools?
- What is the impact of parents’ adoption of ready-made digital curricula on reducing learning loss among elementary school students?
- Does the school’s governing body (public, private, or UNRWA) affect the availability of ready-made digital curricula?
- To what extent can the availability of access requirements for digital programs (such as a mobile device, computer, internet, and knowledge of how to access platforms) affect the effectiveness of digital programs?
- To what extent can ready-made digital curricula serve as a substitute for e-learning to overcome educational crises?
- Do private digital curricula (not affiliated with official bodies) help reduce educational loss?

Answering these questions will help determine the importance of ready-made digital curricula and their role in enhancing elementary schools’ response to educational crises, the readiness of digital platforms to deliver digital education to elementary students, and whether there is coordination between these platforms and the relevant authorities at the

Ministry of Education. Answering these questions will also help identify the impact of using ready-made educational platforms on students compared to e-learning users during crises, and whether there are specific requirements for the success of this educational system.

Methodology

Research Approach

To conduct the present study, the descriptive-analytical approach was used, as it is considered the most appropriate method for such a study.

Study Population

The study population consisted of all parents of students in grades 1 through 6 in public, private, and UNRWA schools, The total number of students was 44,222, distributed as follows: 26,541 students in public schools, 12,843 students in private schools, and 4,838 students in UNRWA schools, according to statistics from the Palestinian Ministry of Education.

Study Sample

A random sample was selected, targeting all parents of students in grades 1 through 6 in public, private, and UNRWA schools. A total of 384 valid questionnaires were collected, representing a response rate of 0.9% of the study population. The following table shows the distribution of the study sample by demographic variables.

Research Instrument

To achieve the study's objectives, the researcher developed a questionnaire based on theoretical literature and previous studies. The questionnaire consisted of two sections: the first section included general information such as (the student's guardian, housing, type of school, grade level, whether the student owns a personal e-learning device, and if so, the type of device; if the student does not own a personal device, whether they follow online lessons; whether internet access is available at home; and whether the school provides ready-made lessons via online platforms? Does the school provide ready-made digital curricula for students during crises? Does the school work to provide digital curricula continuously, regardless of crises?) The second section includes the survey items, which are 24 items, all of which focus on measuring the role of ready-made digital curricula in enhancing the response of elementary schools to educational crises in the Nablus Governorate.

Validity of the Raters

The study instruments were presented to six reviewers, and modifications, additions, and deletions were made based on the reviewers' comments. The validity of the instrument was also verified statistically by calculating Pearson's correlation coefficient for each item in the study with its total score.

1. The results showed that the Cronbach's alpha reliability coefficient for the total score of the scale was high, as the Cronbach's alpha value for the total score was 0.913, indicating that the scale has a high degree of reliability. This suggests that the scale is valid for application and for achieving the study's objectives.
2. The study data were analyzed after applying the instruments to the study sample, using the Statistical Package for the Social Sciences (SPSS), by extracting frequencies and percentages, arithmetic means, standard deviations, Cronbach's alpha, and Pearson's correlation coefficient.

Analysis

A review of previous studies—which, despite differing in their approach, agree on the importance of integrating education with technology and harnessing technological advancements to overcome educational challenges in general and educational dropout and discontinuation in particular—reveals that These studies emphasize the importance of e-learning in conflict zones in general and in Palestine in particular, as the lack of political, security, and economic stability in the Palestinian education system has driven teachers and government sector employees to engage in a series of consecutive strikes over salary payment issues, was a key factor driving officials at the Ministry of Education to seek an educational alternative during times of crisis.

However, researchers believe that treating crises as mere reactions will not ensure the continuity or quality of education. This means that distance learning must be sustainable and take various forms, such as ready-made digital curricula that serve as a reference for students at all times, helping them maintain continuity in their learning and ensuring its quality. Previous studies have highlighted the importance of integrating artificial intelligence into the educational process and its role in raising and improving academic achievement levels. Some of these studies have also shed light on the obstacles and challenges educational institutions face in navigating this new phase of educational development. These studies, along with the questions and inquiries they raised and the recommendations they produced, have had a significant impact on enriching knowledge and guiding researchers toward new insights in their field of study.

Through life experiences and practical and academic expertise, researchers have observed the importance of incorporating technological advancements into the educational process to ensure its continuity and the quality of education, However, given what has been addressed in previous studies on e-learning and its obstacles, it was necessary to find solutions that ensure these obstacles are overcome while maintaining the quality and effectiveness of education, especially since the study targets students from first through sixth grade, meaning that the educational process must provide a stimulating, enjoyable, and safe environment. This is where the importance of this research lies: in determining the extent of the need for ready-made digital curricula provided by schools and supervised by official authorities, so that these curricula cover the core subjects of the curriculum and are accompanied by activities that engage students, ensuring that these curricula are available at all times on dedicated platforms that do not require an internet connection, This takes into account the unique nature of the Palestinian education system, which is characterized by instability due to political, economic, and social factors, in a country where education is the top priority for citizens, families, and the government, as it is the sole gateway for citizens to the global community.

Findings and Discussion

Through the study conducted by researchers on the importance of providing ready-made digital curricula for elementary school students to support them in making up for lost learning, and to serve as an alternative or supplement to e-learning for authorities, particularly to overcome obstacles, the study's results indicated, with a high degree of agreement, the importance of providing devices to financially disadvantaged students and the importance of developing digital curricula to make them more interactive. The results also highlighted the importance of involving students' parents in training programs on how to use educational platforms. To ensure the accuracy of information and the security

of educational platforms, the study's findings indicated strong support for these platforms to be monitored by an official body that oversees the quality of the educational content provided.

These findings are based on students' previous experiences with learning platforms and ready-made digital curricula, which allowed students the freedom to choose their attendance times, and assistance with homework, not to mention the ability to focus on the material during a pre-recorded digital class compared to a live online class attended by more than twenty students. Digital curricula have helped ensure the continuity of education during crises. Furthermore, a number of teachers use ready-made digital curricula to explain lessons, which indicates that this approach is well-received by students, especially if it offers diverse educational activities that teachers cannot conduct in school due to a lack of resources or safety concerns—such as science experiments—as well as the use of illustrations and simulation videos, which help students better understand the lessons. This is especially true if these digital curricula take into account students' learning motivations—particularly in first and second grades—and account for individual learning differences. All of these factors will have an impact on increasing students' motivation to learn, compensating for educational gaps, and stimulating self-directed learning, not to mention developing students' technology skills and helping them keep pace with rapid advancements in this field.

In summary, after answering the main research question: **What is the role of ready-made digital curricula in enhancing the response of elementary schools to educational crises in the Nablus Governorate?**

Following a statistical analysis of the data and the calculation of means and standard deviations regarding the role of ready-made digital curricula in enhancing the response of elementary schools to educational crises in the Nablus Governorate, the data indicates that the role of ready-made digital curricula in enhancing the response of elementary schools to educational crises in the Nablus Governorate was high, as the arithmetic mean of the total score was (3.40) with a standard deviation of (0.66). Data analysis shows that the statement "Devices should be provided to financially disadvantaged students" ranked first with an arithmetic mean of 4.42 and a standard deviation of 0.88. The second-ranked item was "Digital curricula should be developed to be more interactive," with an arithmetic mean of 4.32 and a standard deviation of 0.70, and the third-ranked statement was "Parents should be trained to use educational platforms," with a mean of 4.17 and a standard deviation of 0.69.

Conclusion

Based on the findings of previous studies and the results of the current study, the researchers emphasize the importance of strengthening the role of ready-made digital curricula in schools, particularly at the elementary level (grades 1 through 6). The researchers recommend that the Ministry of Education and relevant authorities create an environment conducive to the official provision of ready-made digital learning platforms for all curricula, ensuring that these platforms are secure, vetted, and achieve the desired educational objectives for each subject. In addition, relevant authorities within the Ministry of Education should work to provide a unified digital educational platform that offers model lessons for elementary school students, supported by student-engaging teaching tools, and presents information in a simple, entertaining, and educational manner that ensures the accurate delivery of information. It covers the skills required for

elementary school students, such as proper pencil grip, correct pronunciation of letters and their articulation, and other skills required for this grade level. It is accompanied by assessment templates monitored by schoolteachers or another supervising body designated by the Ministry of Education. Given that students currently use private platforms as a reference, researchers believe it is important for relevant authorities to encourage private educational digital platforms to develop model lessons for students that support the official platform of the Ministry of Education, while monitoring these platforms and ensuring their quality and security.

The researchers believe that the digital education system cannot succeed without parental cooperation, which requires training parents on how to use these platforms and informing them of their importance, whether through meetings with parents at schools or by providing instructional videos sent to parents. This should be accompanied by collaboration between the Ministry of Education and an entity with expertise in providing offline educational platforms, as well as drawing on the experiences of other countries, such as the Central African Republic. Given the importance of scientific research in analyzing the problem and proposing appropriate solutions, the researchers believe that this research paper can serve as a foundation for more specialized and extensive research in Palestine or other countries.

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Language Acquisition in Children with Cochlear Implant in Punjab Province, Pakistan

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Abstract

In this research, the researcher is trying to find out strong reasons that why language acquisition process is still suffering despite cochlear implantation. Language and speech are sources of expression for what the individual is feeling and mental state (thinking). Perception of speech encompasses various aspects, including recognizing phonemes, combining them to form words sentences, and extracting meaning from the linguistic content (Tezcan, F et al., 2026). In children with hearing issues and as well as children with cochlear implant faces many issues even in this era of Artificial Intelligence. Although cochlear implant has been common in Pakistan, but language and speech issues are still a heading in children's daily life which prohibits them in educational and social interaction goals. In this research, the researcher has developed a self-made questionnaire (with pilot testing) and tries to enlist the challenging factors of the children with cochlear implantation for language acquisition. As well as the researcher will assess the children current level of language and speech. In this process we find the old cochlear implant users which are not getting benefits from traditional style of speech therapy. We include those children (cochlear implant user) who are getting speech therapy from one year (minimum) and three years (maximum). Data has been analyzed through Excel and SPSS. Frequency measures have been used to find out the results which show these main factors which are Cost of therapies, Education of parents, Awareness of parents, No accountability procedure, Age of the patient.

Keywords: CIU (cochlear implant users), Hearing impairment, Language, Language Acquisition, Speech Therapy (ST), SPSS (Statistical Package for Social Sciences)

Introduction

Language and Speech perception refers to an ability to perceive linguistic structure in the acoustic speech signal. During acquisition of native language, infants must discover several levels of language structure in the speech signal including phonemes (Houston, D. M. 2022). Language is also considering as a science of cognitive and social activities, like face-to-face interaction, verbal expression gestural cues with organized and ordinary manners (Masood et al., 2024).

Review of Related Literature

Before the development of speech and language children need to achieve some pre-linguistic skills like response to the environmental stimulus like events and people but our children with hearing issues feel difficulty regarding this (Esbensen, A., & Grenner,

E., 2023) Another element which is very important for language development is development of attention span according to age because for the proper response to environment the children have to pay attention to any stimulus. After that the development of join attention and its shifting have the same role in pre-linguistic skills. If any child will not develop join attention he or she will not learn how to interact with the surroundings and unable to cope with other individuals (Porcar-Gozalbo., et al., 2024). Development of imitation (gestures, sounds and words) and their usage is crucial for acquiring language because if the child will not learn imitation won't be able to use language (Khorramshshi, H., et al. 2024). Initiation of interaction with others is also a milestone of language acquisition by giving social smile and gestures a child will learn how to start interaction with strangers and known individuals. It is early form of communication. The use of gadgets appropriately and happily is also important. Adequate use of technology can help interaction and learning in children; after that turn taking skill comes for maintain socialization and social relationship. Lastly receptive language has the most important for language acquisition (Kennedy, C, R., et al. 2022). All these skills need to develop before language acquisition but children with hearing issues seems to have lacking behind these skills. Understanding of what other people are saying or communicating has equal importance to speech and language development but in children with hearing impairment faces issues in understanding of verbal stimulus and in language development (Esbensen,A., & Grenner, E 2023). The first years of life children normally started to speak with some nouns, but due to hearing lose the children are unable to develop the speech and language according to their peer group, like after 18 months till 30th months the children started word combination and 30th months to 48th months normally children started complex sentences with the usage of morphological markers like plurals, relational word and gender discrimination (Houston, D. M. 2022).

A core characteristic of individuals with hearing impairment is delay in receptive and expressive language and communication (Karla, 2020). 50% of the children with hearing impairment do not develop speech up to the required level to meet their basic needs (Oghalai, J. S., et al. 2024). These individuals cannot use conventional means of communication due to their impaired hearing (Sinha, A., & Kumar, T, 2024). They also face some problems to follow linguistic and grammatical rules like missing of helping verbs, use of prosody as well as some Articulation error (Esbensen, A., & Grenner, E. 2023). It is usually observed in Pakistan children with cochlear implant do not achieve language level to such extent with which they can communicate in society properly and actively. There are many reasons but mostly children are implanted after the age of 5-6, often later due to delay diagnosis and so on, and till that age they use learn communicate with sign language and gestural, visual cues (Rashid, A. et al., 2023). Total Communication may enhance language acquisition more efficiently and quickly in cochlear implant users. Sometimes traditional hearing aids may not provide sufficient amplification for individuals for with severe to profound hearing loss. Even the most powerful hearing aids are unable to provide enough meaningful information for environment sound detection or speech perception for these individuals (Hickson, L.et al., 2020). In the case, the powerful digital hearing aids like Cochlear Implant helps people to provide an opportunity to receive information with their impaired auditory system (Sutton, A. E. et al., 2025). The cochlear implant is an electronic device that can amplify sounds and refers to an improved language acquisition of children with severe to profound hearing loss (Muzaffar, J., et al 2025). All kind of struggle for cochlear implant users are made for language acquisition, so by-passing pre-linguistics skills step by step the children may enhance language and able to interact with other hearing people

(Hardman, 2022). These efforts do not give ample reward for language acquisition in children with cochlear implant. It is observed many cochlear implant users are failed to get progress in language and communication skills despite of all efforts.

Objectives

To identify the key factors affecting language acquisition in children with cochlear implants, assess their current speech and language levels, and examine why traditional speech therapy shows limited effectiveness. The study also aims to analyze the impact of parental awareness, education, therapy cost, accountability, and age on children's linguistic and social development.

Methodology

The researcher employs a quantitative research methodology and collects the data of 300 cochlear implant users age range will be 6 to 8 years through initial survey and gathered the information about those children who are not getting many benefits from speech therapy even they are getting session from one year minimum and three years maximum. The researcher assessed the child's performance through informal (self-made) questionnaire (screening tool). The population of the study are children with cochlear implant from different institutes of Punjab, Pakistan. The sample will be selected from different clinics, hospitals and institutes who provide different services to cochlear implant users. The multi-stage random sampling technique will be used to determine the sample of the study. The age range of these children will be 6-8 years, without any gender discrimination.

Findings and Discussion

Table 1. Frequency distribution on the basis of education of the parents.

Qualification	**F**	**%**
Metric	168	56
F.A	63	21
B.A	42	14
M.A	16	5.33
M.Phil.	11	3.6
Total	300	300

The table 1 of the frequency distribution shows that there are only less parents which are highly qualified and matriculation is high in numbers, that's why people with low education are facing more difficulties in the treatment of their children regarding language acquisition.

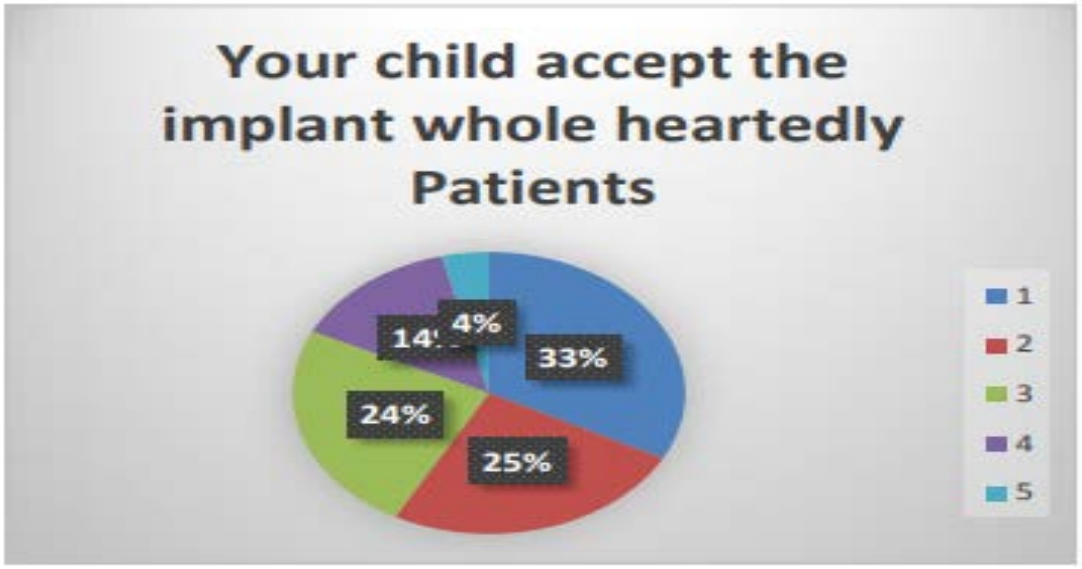


Figure 1 is showing that only 4% children accept the cochlear implant whole heartedly.

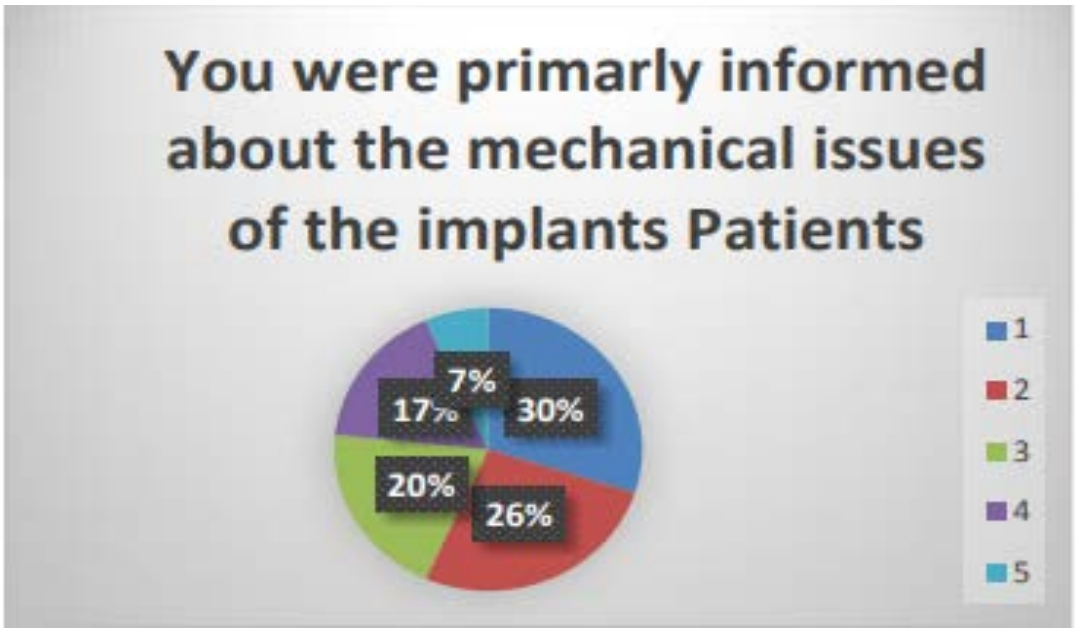


Figure 2 is showing that only 7% people were primarily informed about the mechanical issues of the plant.

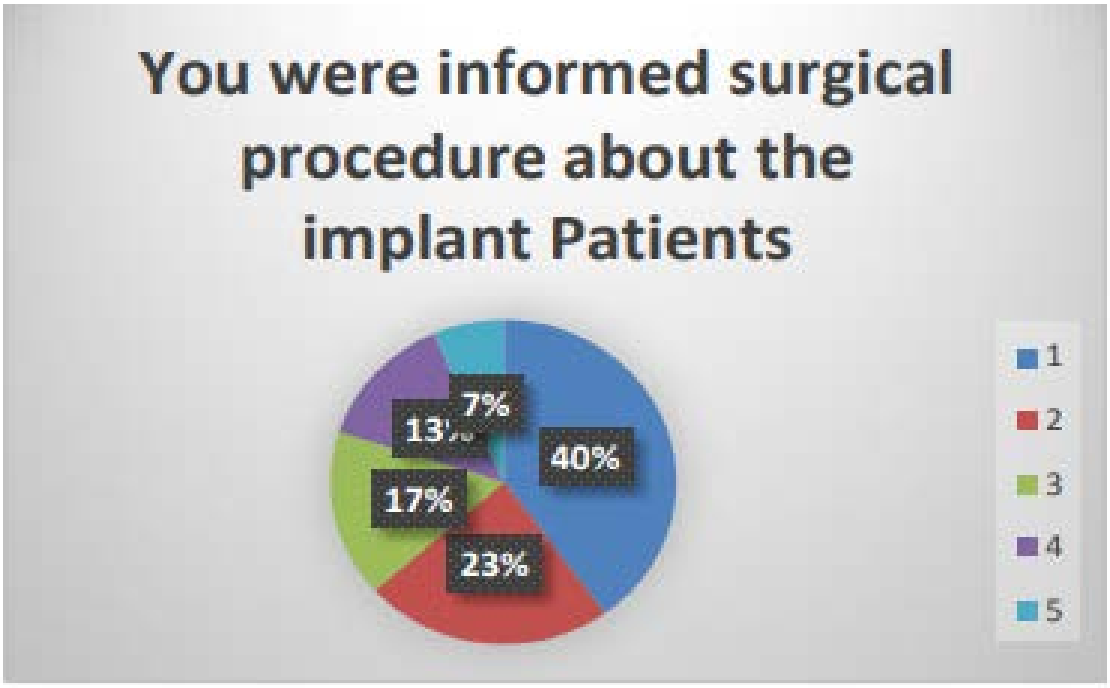
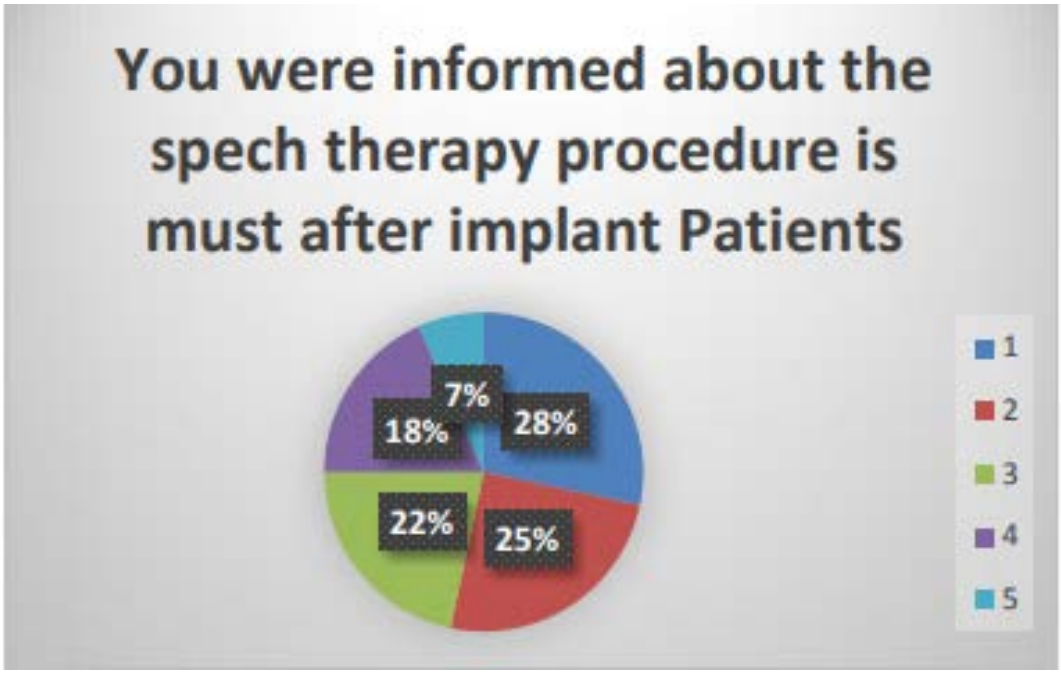


Figure 3 shows that only 7% people were informed about the surgical procedure of implant.



Above mentioned figure 4 is showing that 25% parents are willing to say that they were not informed about speech therapy procedure and only 7 % were informed properly.

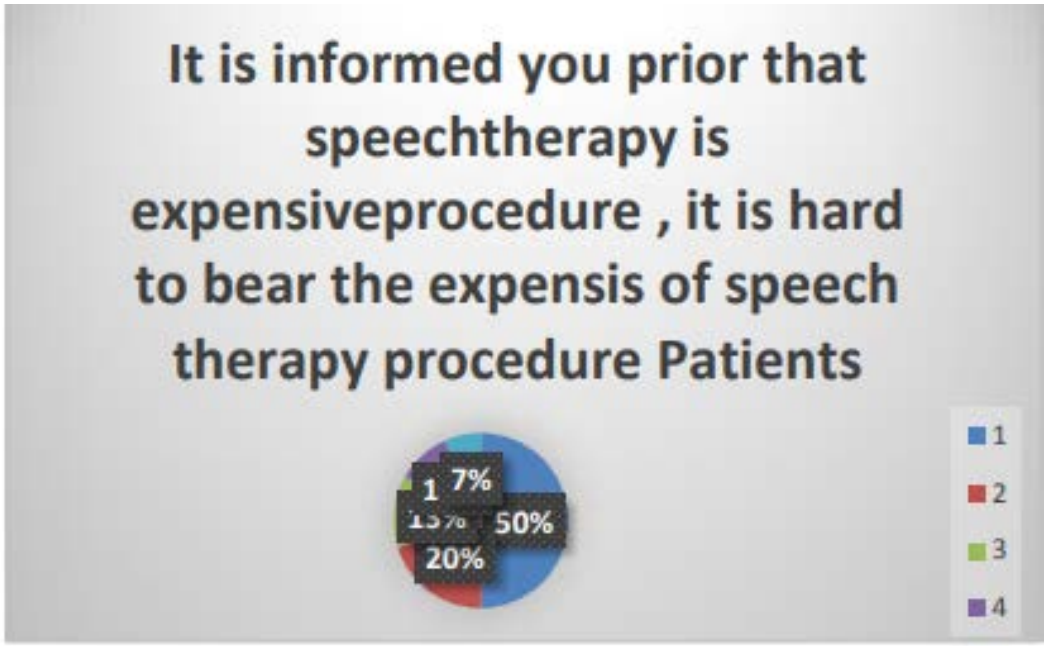


Figure 5 is showing that it is 50% of the patient were not informed that speech therapy is expensive procedure.

Above mentioned figure 6 showing that 32% parents were strongly agree on this statement which is showing that it is difficult for them to travel for speech therapy.

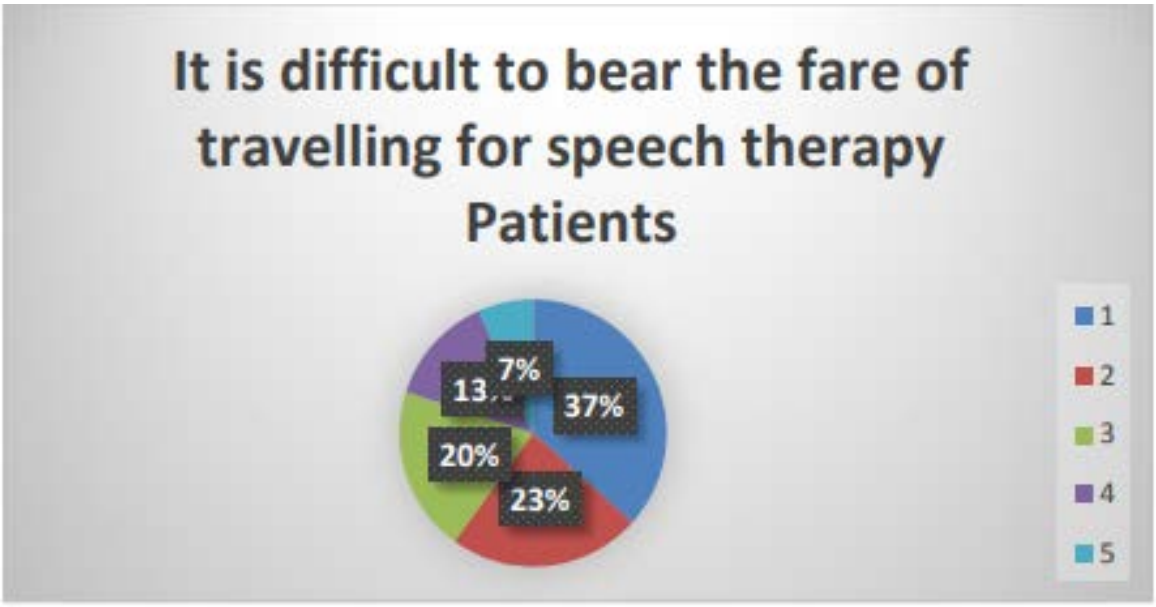


Figure 7 is showing that 37% were strongly agree that it is hard for them to bear the fare of travel for speech therapy.

In figure 8 we can see that only 10 % people are strongly agree on that they can manage their time for speech therapy and 29 % people find its hard to manage the time for speech therapy for their children.

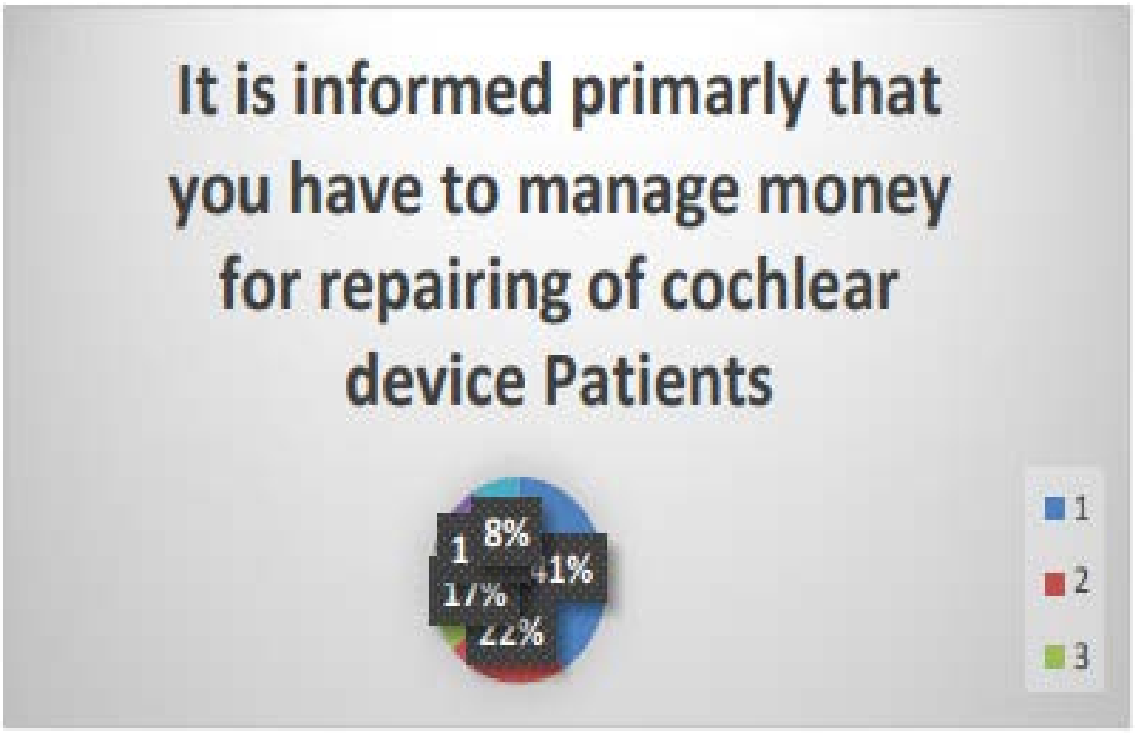


Figure 9 is showing that 41% parents are strongly disagree with this statement that they were primarily informed about the cochlear device management expensis.

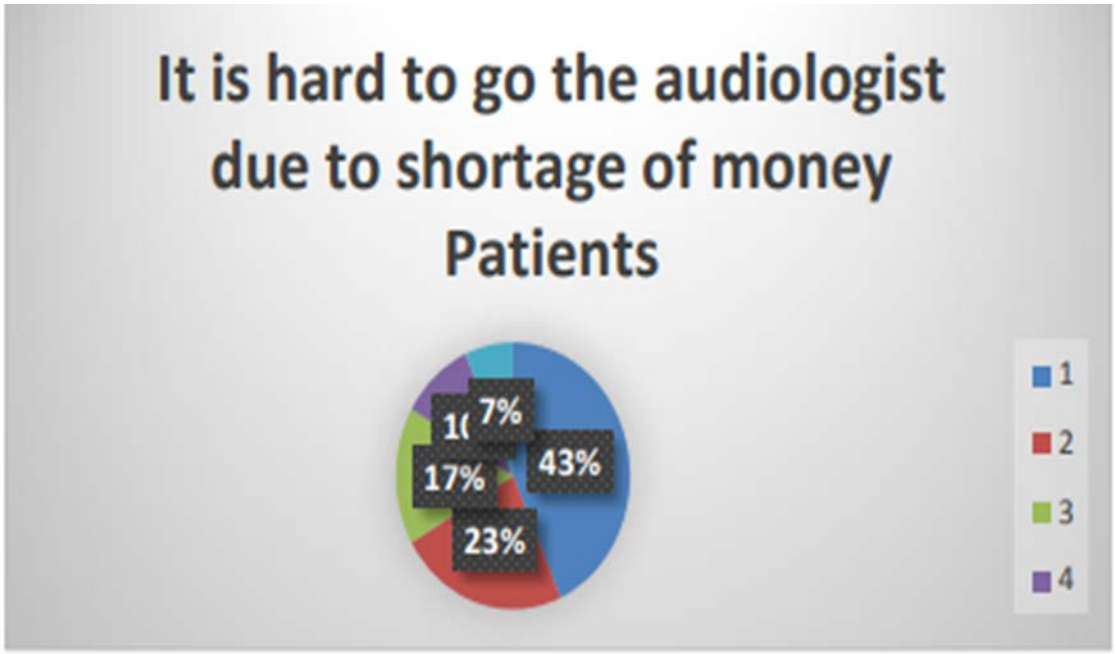


Figure 10 is showing that 43% patient were found with the shortage of money for audiologist's visits.

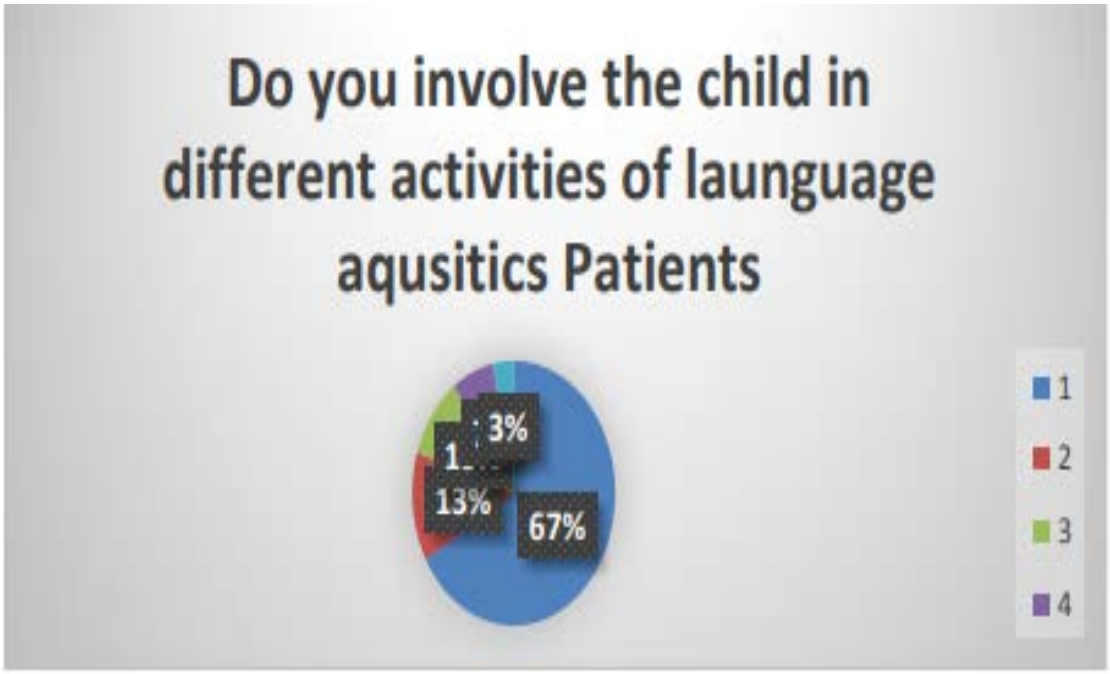


Figure 11 is showing 67% patients are strongly disagree with this statement that their children were involved with language acquisition activities.

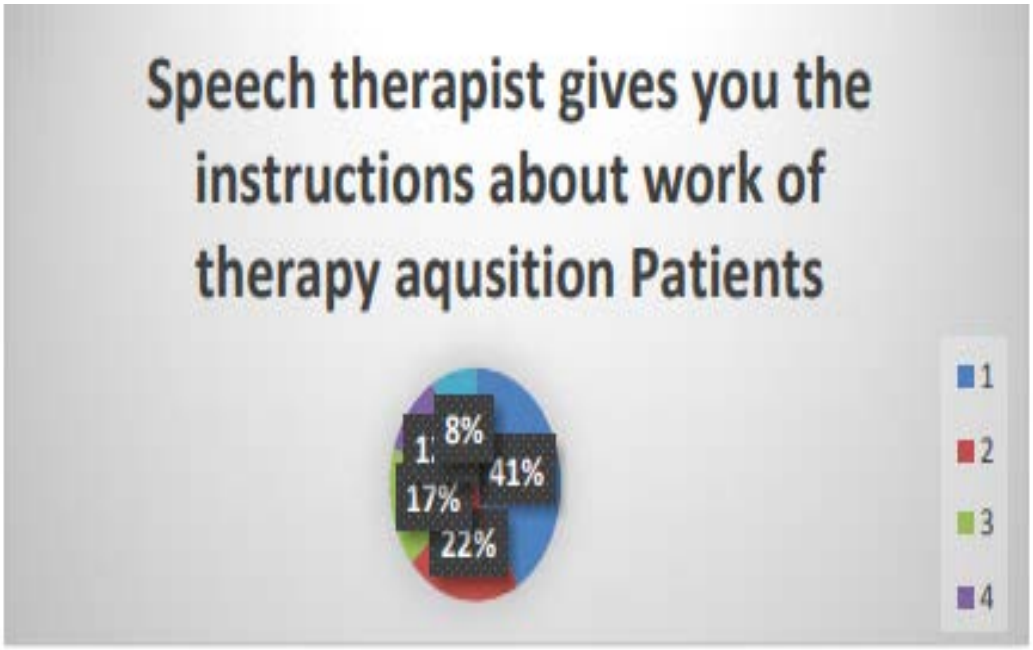


Figure 12 is showing that 41% strongly disagree with it that their speech therapist gave instructions about work at home.

Figure 13 is showing that 43% parents are strongly disagree with the statement that they can follow the speech therapist instructions easily at home.

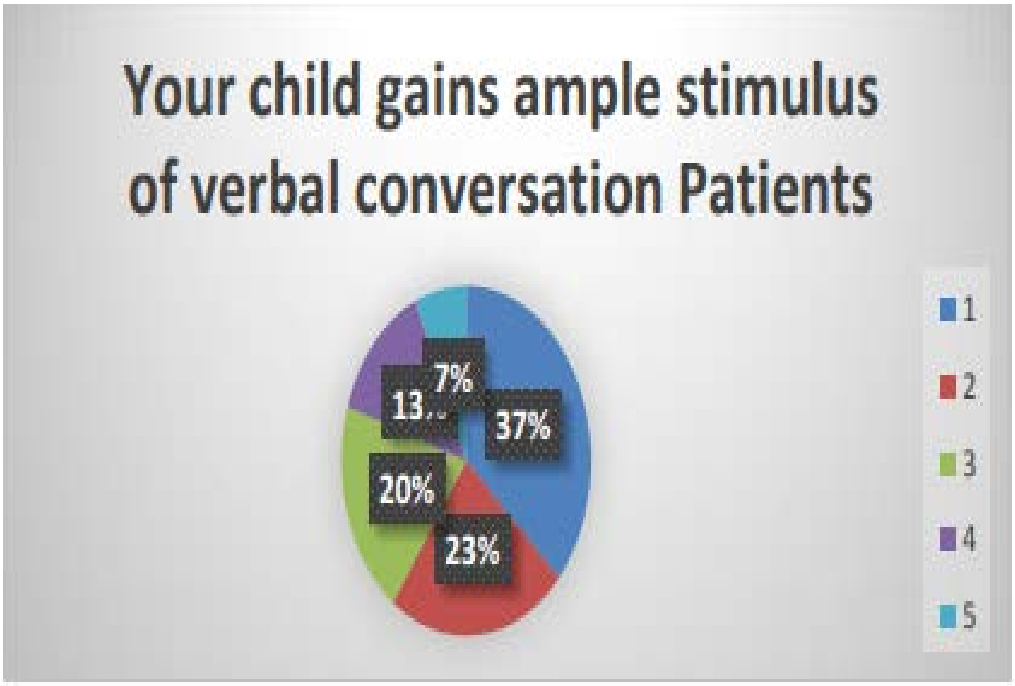


Figure 14 is showing 37% people are strongly disagree on the gain of ample verbal stimulus.

Figure 15 shows that 65% parents are strongly disagree about the statement of asking the speech therapist about the home practice.

Figure 16 is showing that only 17 % parents are strongly agreed and 22% are agree with the statement about their children's speech therapist did not get irritable on questioning of the parents about speech practice.

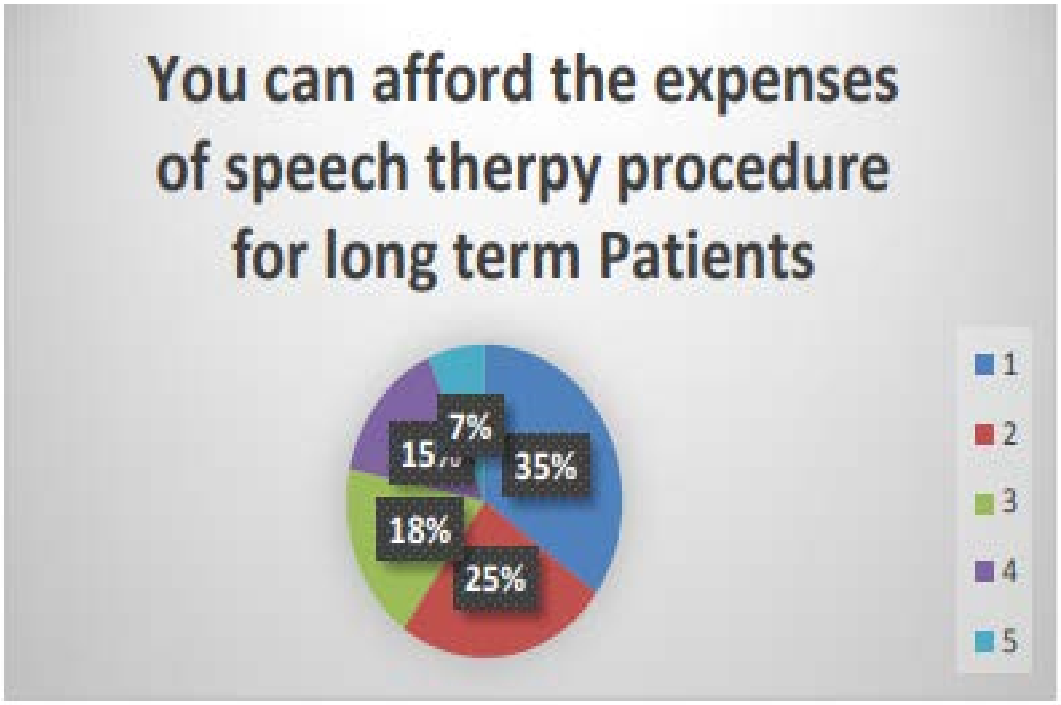


Figure 17 shows that only 7% parents can afford the expenses of speech therapy procedure for long term.

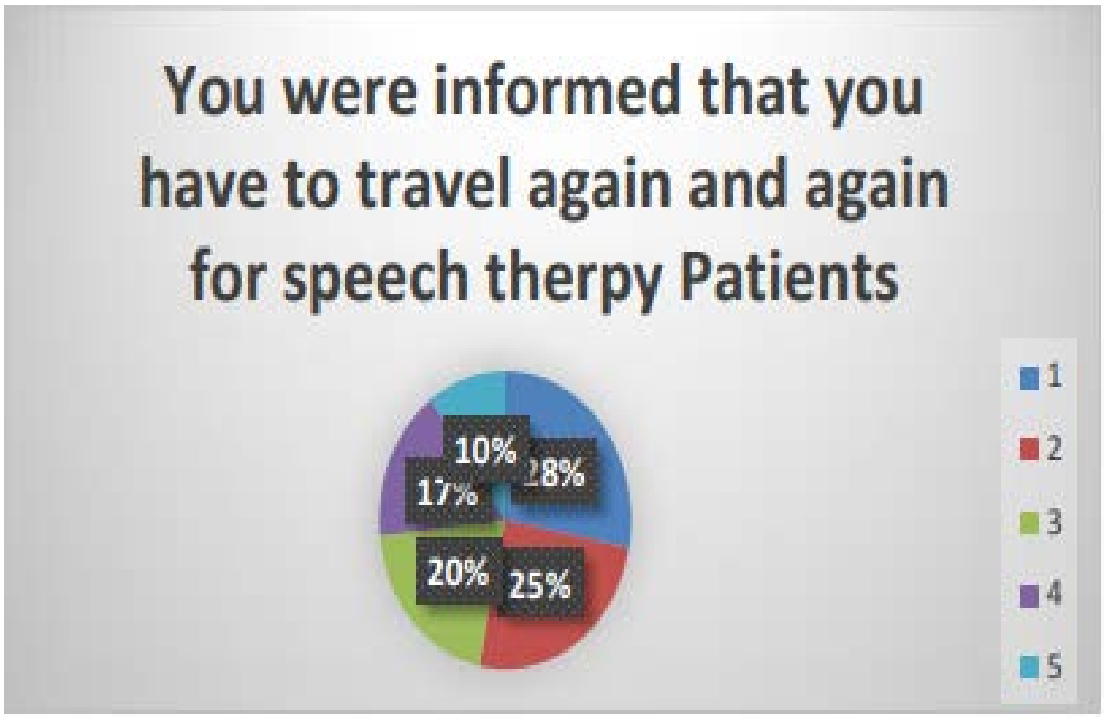


Figure 18 is showing that only 10% people and strongly agree with this statement that they were informed that they have to travel again and again for speech therapy of their children.

Conclusion

Above mentioned results show that parents of children with cochlear implant users are still facing may issues regarding their finance, procedural, surgical, technical, traveling and awareness.

The results show that in Pakistan poor economy of parents leads them to discontinue the therapy system but well-educated parents to somehow tried to manage but they are few in numbers. It is keenly observed that many of the parent of cochlear implant users come from far away from hospitals, clinics, institutes and therapy centers. So that they find it hard to go again and again for speech therapy. By keeping this thing in mind, the government should promote therapeutic services and therapy centers in every district and major areas of villages and different towns from government.

On the other hand, an accountability system should be introduced by the government, so if any of the patient does not follow the instructions about speech therapy and auditory verbal training will face the hard steps or charge fine. In Pakistan the education of the parents also plays vital role, as well as awareness of the parents is a big hurdle for children with cochlear implant.

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Transforming Chemistry Education through Digital Tools: Enhancing 3D Visualization and Conceptual Understanding

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Abstract

Chemistry is inherently a three-dimensional (3D) science, yet it is often taught using traditional two-dimensional (2D) methods such as black boards, whiteboards, and textbooks. This mismatch creates a “conceptual gap” for students, particularly in areas like molecular symmetry, solid-state chemistry, and stereochemistry. This paper explores the use of interactive 3D visualization tools such as Jmol, ChemTube3D and Symmetry@Otterbein in the classroom to enhance molecular understanding. These tools allow students to rotate, reflect, zoom, and perform symmetry operations and identify point groups in real time. Using Jmol open-source 3D molecular viewer, students can visualize and analyze molecular symmetry and point groups with the help of console commands. By utilizing the “Show All Symmetry Elements" in the control tab of Chemtube3D, students can find out individual symmetry operations and identify the point group. The resources included in Symmetry@Otterbein web-based educational tool are specifically designed to help students learn molecular symmetry concepts and to aid teachers in providing live demonstrations of topics that are challenging to convey through verbal explanations, hand-drawn illustrations, or even physical models. By incorporating these tools into the classroom, students can develop a more intuitive and practical understanding of complex concepts. At the same time, teachers can transform their pedagogy from passive lecturing to a dynamic, interactive, and student-centered approach, thereby fostering deeper understanding and improved retention of challenging chemical concepts.

Keywords: Active Learning, Chemistry Education, Digital Tools, Molecular Symmetry, 3D Visualization

Introduction

Chemistry forms the foundation for understanding many other scientific fields, including biology, physics, geology, materials science, and environmental science. In order to enhance students' comprehension of chemistry concepts and theories in a variety of contexts such as molecular symmetry, solid-state chemistry, and stereochemistry, 3D visualization digital tools should be included into chemistry education. The use of these powerful tools in teaching chemistry education to enhance student learning process and it is necessary to discuss about the incorporation of these tools into teaching and learning processes for offering innovative ways of teaching (Kubiliene et al., 2024). The inclusion of digital tools in the educational sphere brings new cognitive activities into practice, as they are highly interactive and practical in the classroom. Digital tools enable the construction of knowledge, facilitate interaction and stimulate students towards

meaningful learning. In the 21st-century digital era, Teachers are in a position to expand their digital knowledge and use digital tools in teaching to create a student-centered transformative approach and enhance student's learning processes (Nino, 2023).

Review of Related Literature

The present study explores the use of new digital technologies in the teaching of Group Theory in Chemistry, focusing on active methodologies that seek to overcome the traditional teaching model. The main objective was to understand how digital technologies can improve the teaching-learning process of Symmetry concepts in Group theory. 3D visualization tools are a game-changer for teaching molecular symmetry, a topic that faces challenges using 2D paper diagrams. The challenges include identifying symmetry elements (□-plane of symmetry, Cn-proper axis of rotation, Sn-improper axis of rotation and i-centre of symmetry) and determining point groups. By moving beyond static images, these tools transform how students understand the mathematical and physical balance of molecules. This paper explores the use of interactive 3D visualization tools such as ChemTube3D, Jmol, and Symmetry@Otterbein(symotter.org) in the classroom to enhance molecular symmetry understanding. These tools allow students to perform all symmetry operations such as rotation, reflection, inversion in real time and identify point group and list down all symmetry elements present in any molecule.

Objectives

This paper explains the different 3D visulalization tools used for teaching symmetry concepts with animation. ChemTube3D, Jmol, and Symmetry@Otterbein(symotter.org) tools are particularly used for teaching molecular symmetry in 3D view with animation and make students to develop a more intuitive and practical understanding of symmetry concepts in group theory.

Methodology

ChemTube3D is an Open Educational Resource (OER) that contains interactive 3D chemistry animations and structures. ChemTube3D.com has been available to the educators and learners as an Open Educational Resource since January 2008. The number of symmetry elements such as axis of rotation (Cn), plane of symmetry (□v , □h and □d), centre of Symmetry(i), and improper axis of rotation(Sn) present in any molecule can be found out, by clicking Symmetry under Structure and Bonding menu on ChemTube3D. (Figure 1).

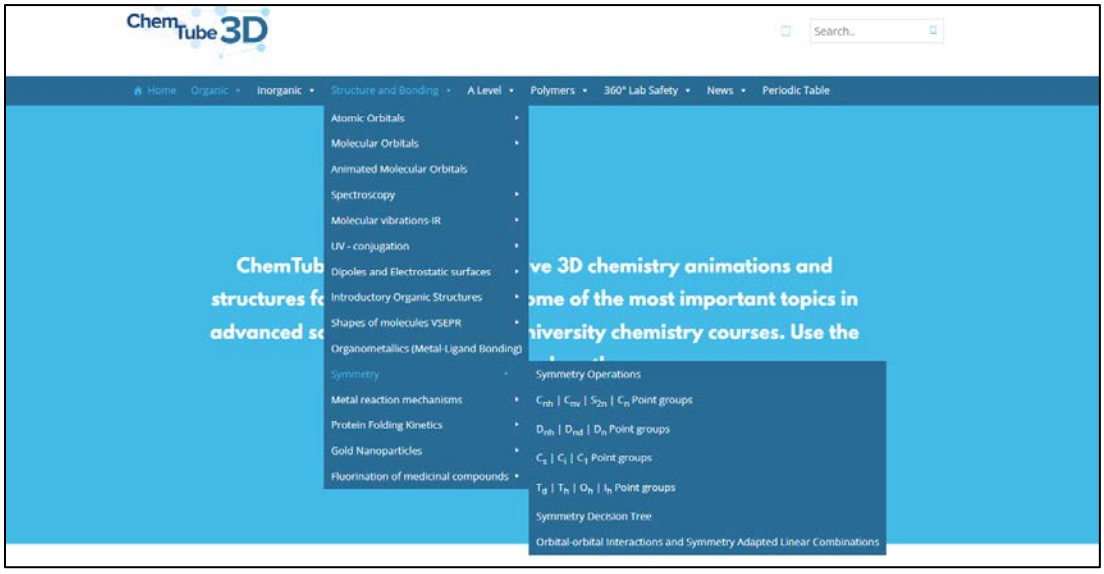

Figure 1: Selection of Molecule on ChemTube3D

Analysis

After selecting the molecule (for an example, Octahedral SF_6 molecule under Oh), we can get the following window showing the structure of SF_6 with options to be chosen for viewing symmetry elements and animation (Figure 2).

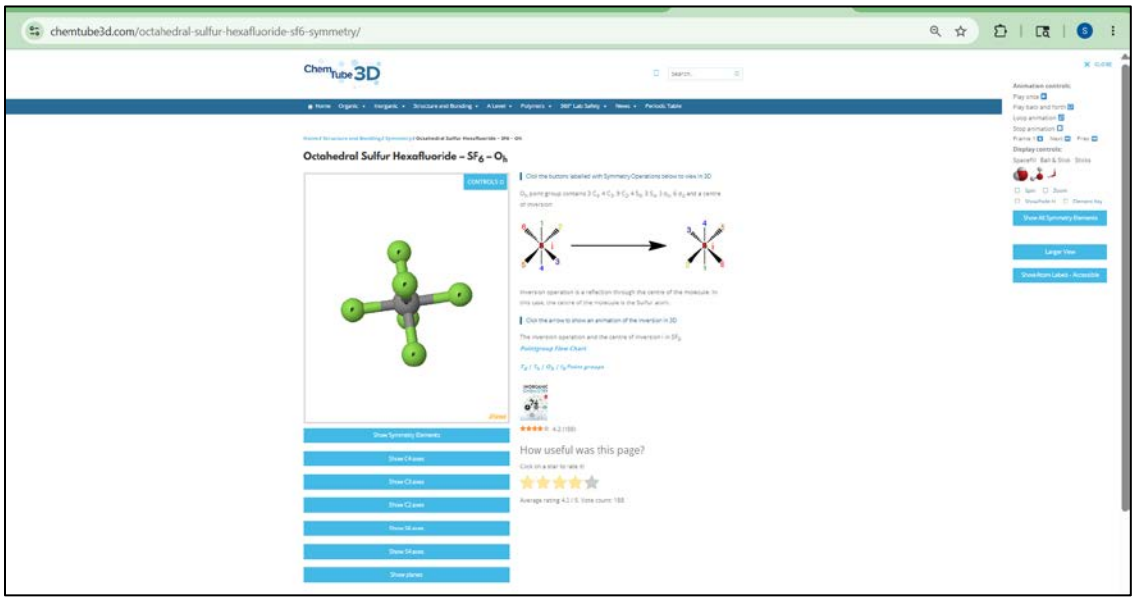

Figure 2: Visualization of symmetry operations in ChemTube3D

Using the “Controls” button, detailed examination of the animation of the molecule for each symmetry operation can be viewed and the “Show Larger View” button gives larger view as well as controls for the animation and display. Total number of symmetry elements can be found out by using all symmetry element button. The molecule can be rotated using mouse and shifting of atoms for each rotation can be easily visualized.

Similarly, Jmol can also be used to view the 3D animation of molecules for each symmetry elements present in it. Jmol is an Open Source molecular viewer licensed under the GNU Lesser General Public License. Jmol is a Java applet that is emerging as a suitable replacement for both RasMol and Chime (which were used as tools for viewing the three dimensional structures of molecules in the mid to late 1990's. Jmol is a free and open source computer visualization powerful program and runs on a Java platform. It is being used as a teaching tool by teachers, researchers and scientists to visualize a molecule in 3D space. Jmol is used either as an independent program by downloading like any other program on a desktop and functions equally well in a PC or Mac environment or as a web application. Jmol has a web-based version (i.e."JSmol") that runs on a JavaScript platform and functions equally well on all HTML5 compatible browsers such as Firefox, Internet Explorer, Safari and Chrome. In Jmol window, at first, the structure of the molecule is obtained by typing the molecule name (for example, Methane - CH4) in input window from “Get Mol” under File menu and the atoms are numbered by choosing label option and the structure is shown in Figure 3.

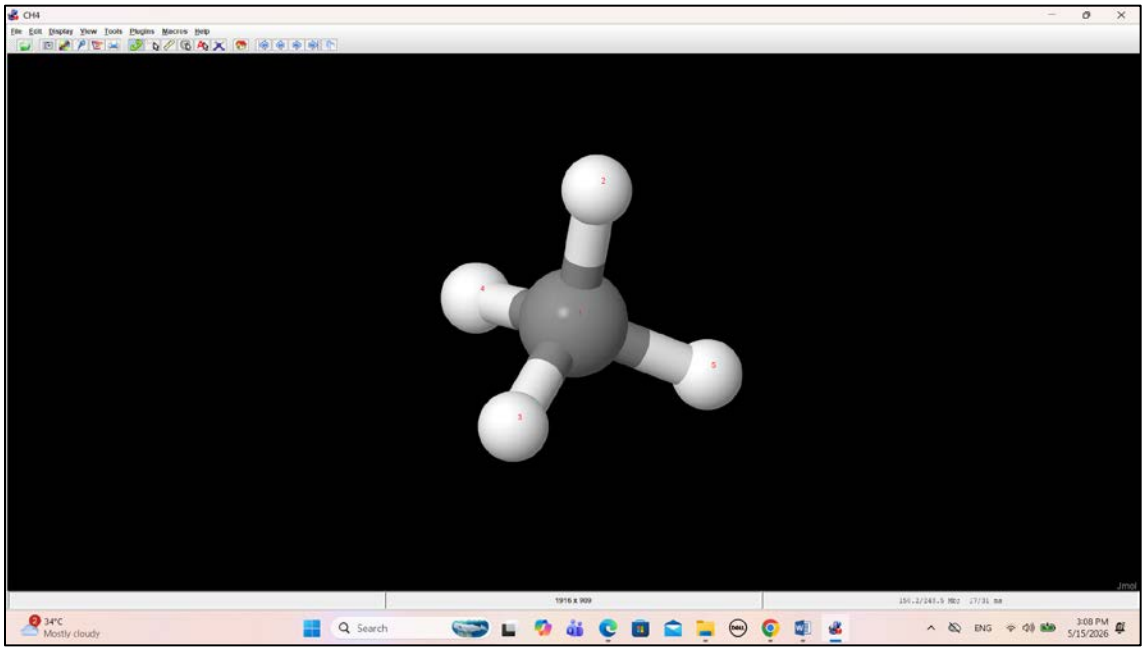

Figure 3: Visualization of CH_4 in Jmol

By giving proper commands (always start with $) in console window, molecules can be rotated about an axis or reflected by choosing a plane and inverted about a point(centre) and point group of any molecule can be easily determined. For example by the giving the following command “$ draw plan 1 300 plane (atomno=1) (atomno=2) (atomno=3)” for methane (CH_4) molecule in Jmol, we get the following image showing the plane having atoms 1(carbon) and atoms 2 and 3(hydrogen atoms) and the image is shown in Figure 4. In a similar way, by giving proper commands in console window, user can add more number of planes with different colours for easy understanding. Animations for reflection and rotation can also be done in real time using Jmol by giving proper commands in Console window.

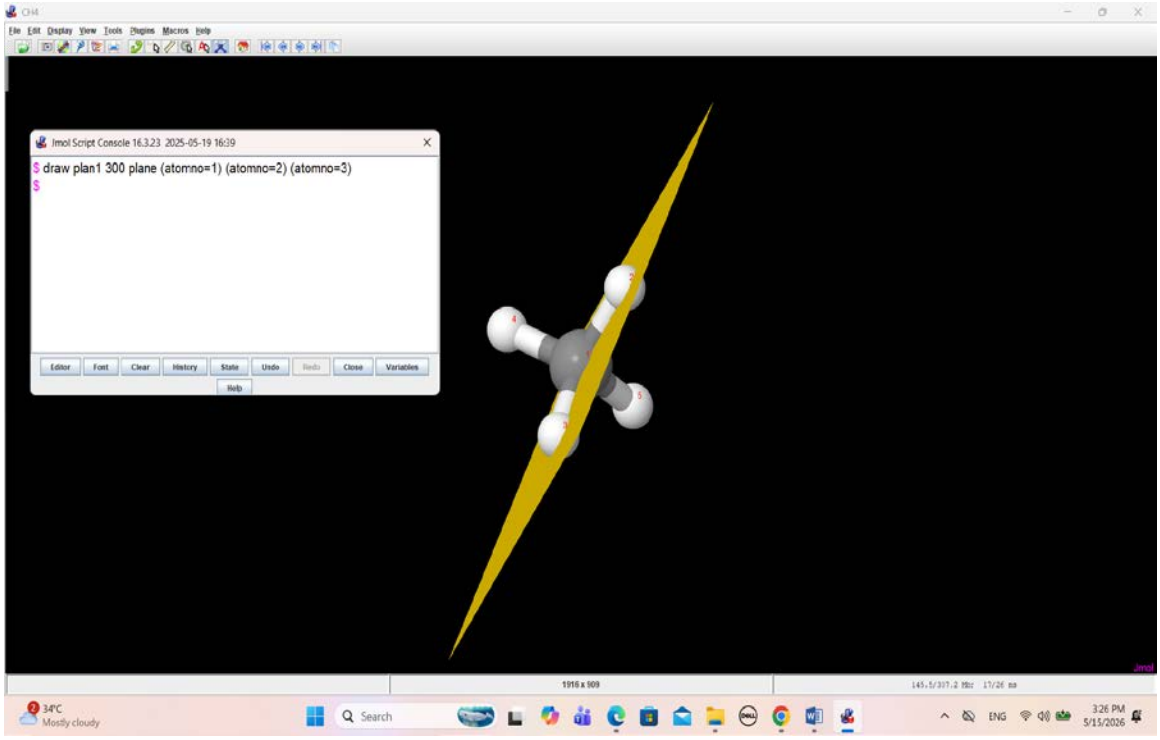

Figure 4: Visualization of Jmol Script Console window with command CH_4 in Jmol

Similarly Symmetry@Otterbein(symotter.org) can also be used as a digital tool to view molecules in 3 Dimension in real time. Symmetry@Otterbein(symotter.org) is a web-based educational tool which helps teachers in providing live demonstrations of different types of symmetry elements and operations and make students to learn about symmetry concepts in group theory. In the Symmetry Gallery of symotter.org has a collection of over 120 unique molecules and polyhedra with interactive display of all symmetry elements and animation of all operations. The molecules are organized by point group in such a way that the user can select examples to demonstrate particular symmetry elements.

Findings and Discussion

Using 3D digital tools teachers can teach the complex and confusing concepts of symmetry elements to students in an attractive way by having them explore to use these tools and learn by hands-on training. For example, to explain the presence of different symmetry elements in Molecules having similar formula but different geometry, ChemTube3D is very useful. For an example consider AB3 type molecules having different geometry. While teachers often find that using 2D methods to teach symmetry elements in AB3 type molecules, such as pyramidal NH3 (Ammonia) and trigonal planar BF3 (Boron trifluoride) to students with 2D methods, teachers found it very difficult to make the students to understand the concept. But when the same concept is taught by utilizing ChemTube3D (a 3D visualization and animation tool), it significantly enhances the interaction and allows students to grasp concepts like rotation axes and reflection planes with greater clarity. For example, consider the determination of symmetry elements present in a non-planar Ammonia molecule (NH3) using ChemTube3D tool. From the ChemTube3D window, one can easily find out how the atoms (N &H) in ammonia molecule shift their position when the molecule is rotated through C3 axis (Figure 5) through animation, reflected through reflection (mirror) plane (□v) (Figure 6)

and all the symmetry elements present in ammonia molecule (Figure 7) excluding identity operation (E).

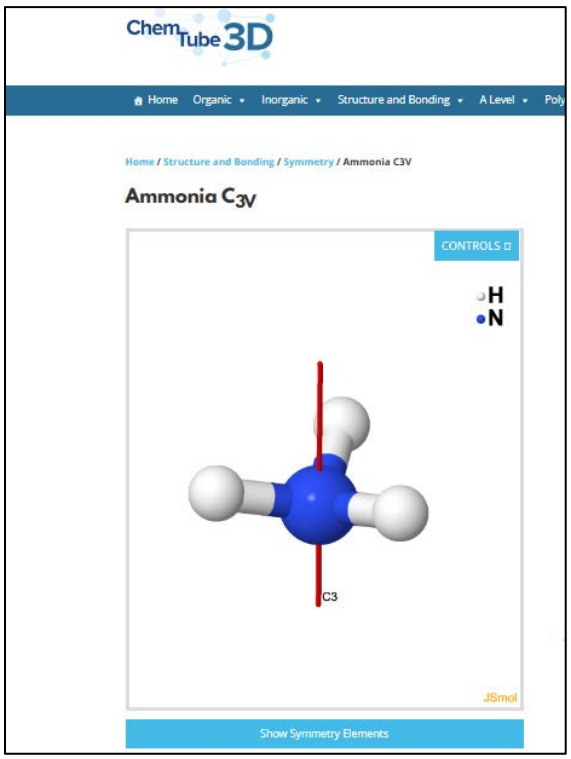

Figure 5: ChemTube3D image of C_3 axis of Rotation in NH_3

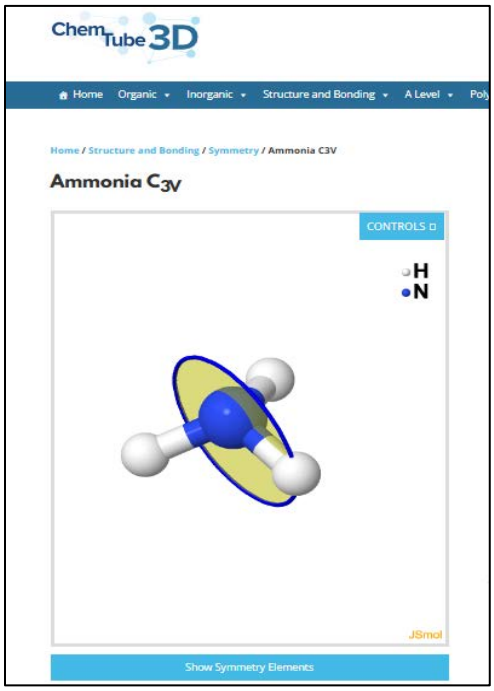

Figure 6: ChemTube3D image of Reflection (mirror) planes (σ_v) in NH_3

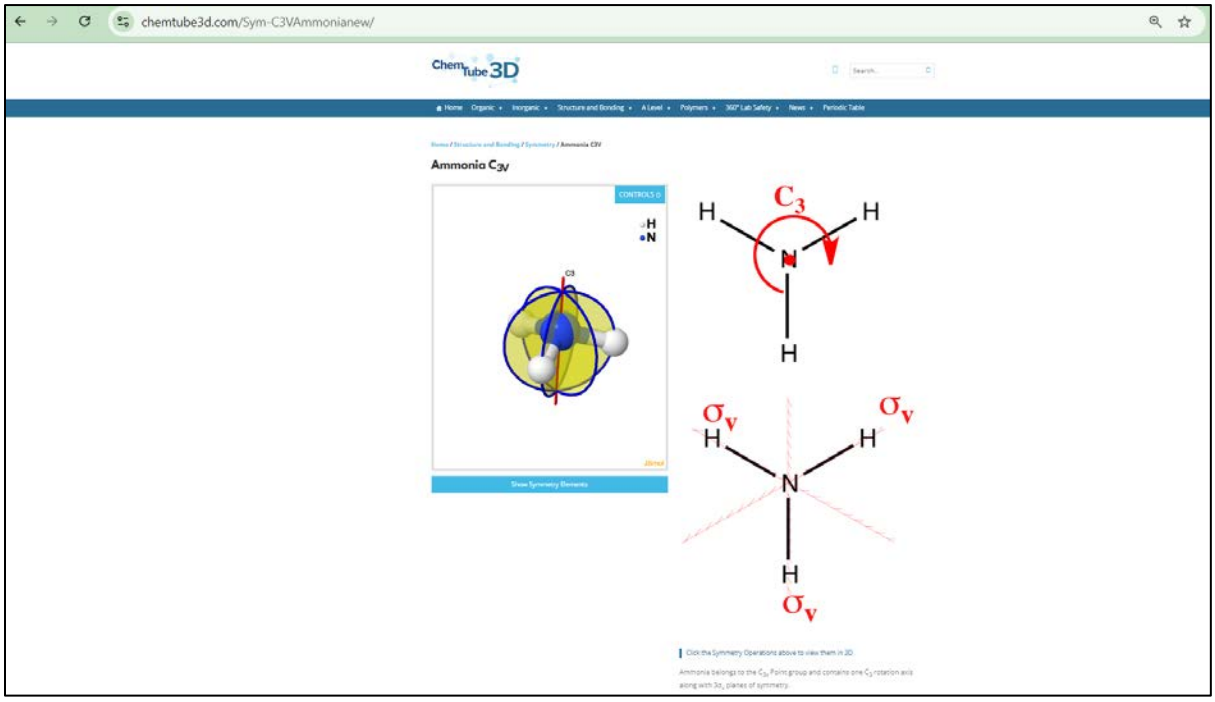

Figure 7: ChemTube3D image of Symmetry elements (C_3 & $3\sigma_v$) of NH_3

Similary, the symmetry elements present in planar Boron trifluoride (BF_3) molecule can be clearly explained by using ChemTube3D. Teachers can easily differentiate between C_3 axis of rotation (Figure 8) and three C_2 axes of rotation (Figure 9) and σ_h plane and three σ_v planes (Figure 10) and through animation in ChemTube3D window.

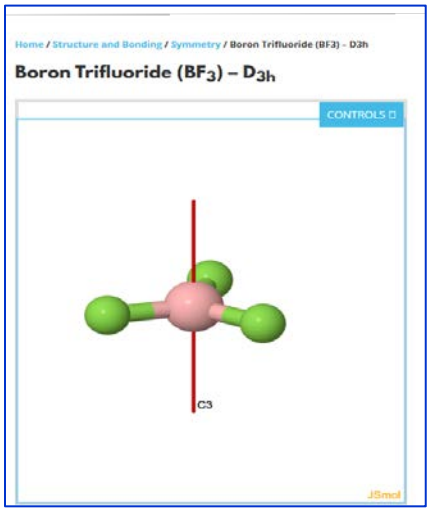

Figure 8: ChemTube3D image of C_3 axis of Rotation in BF_3

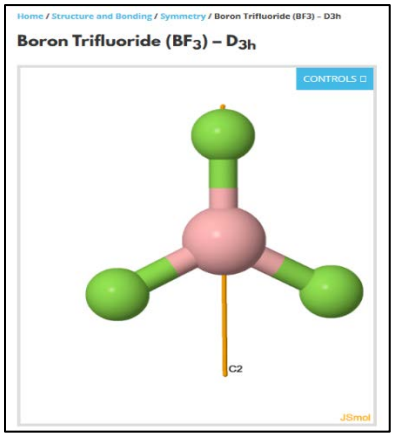

Figure 9: ChemTube3D image of C_2 axis of Rotation in BF_3

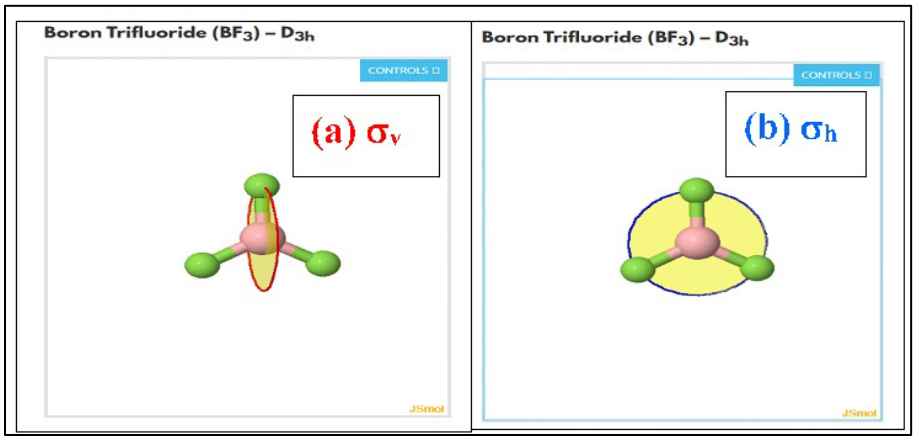

Figure 10: ChemTube3D image of Reflection (mirror) planes in BF_3 (a)σ_v, (b) σ_h

All symmetry elements present in BF_3 is shown in Figure 11 and from the image, user can easily list down the symmetry elements and determine the point group using ChemTube3D.

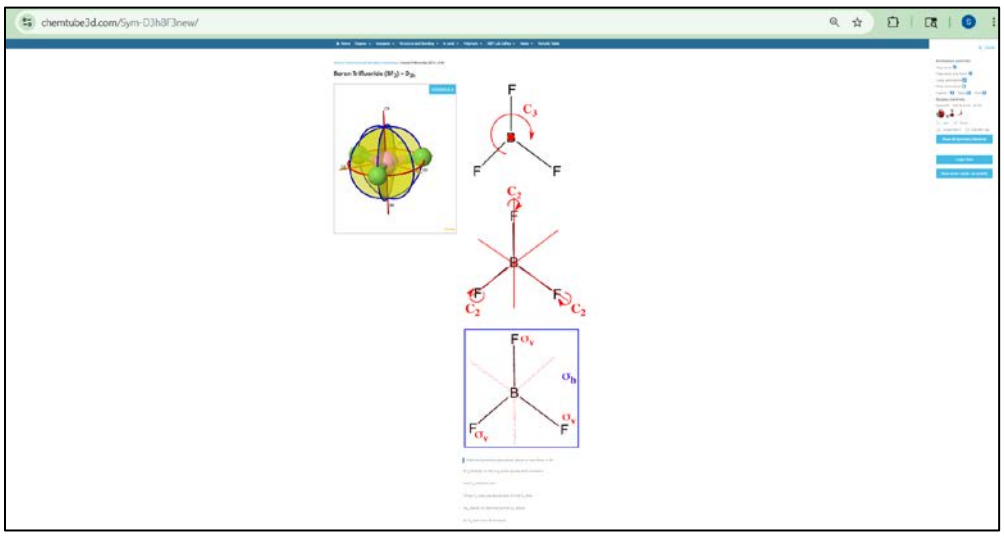

Figure 11: ChemTube3D image of Symmetry elements (C_3, $3C_2$, $3\sigma_v$ and σ_h) in BF_3

Thus by using ChemTube3D tools, teachers can make students to understand clearly unlike Boron trifluoride, Ammonia molecule does not have C2 axis of rotation and □h plane because of non-planar geometry but have C3 axis of rotation and 3□v planes only along with Identity(E) using animation and 3D view.

Similarly by using Jmol digital tool, symmetry elements of molecules can be viewed 3 dimensionally with animation by giving proper commands in Console under File menu. For example, the images obtained for one of the □v plane, C3 axis of rotation, and all symmetry elements present in CH4 by using Jmol open source are shown in Figure 11,12 and 13.

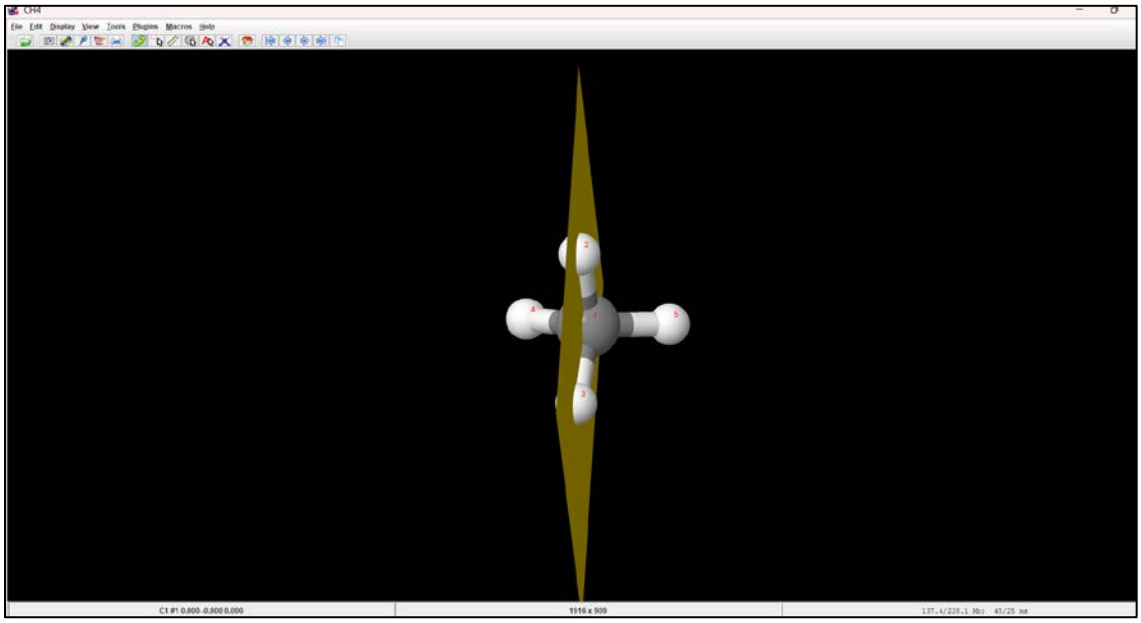

Figure 12: Visualization of a σ_v plane of CH_4 in Jmol

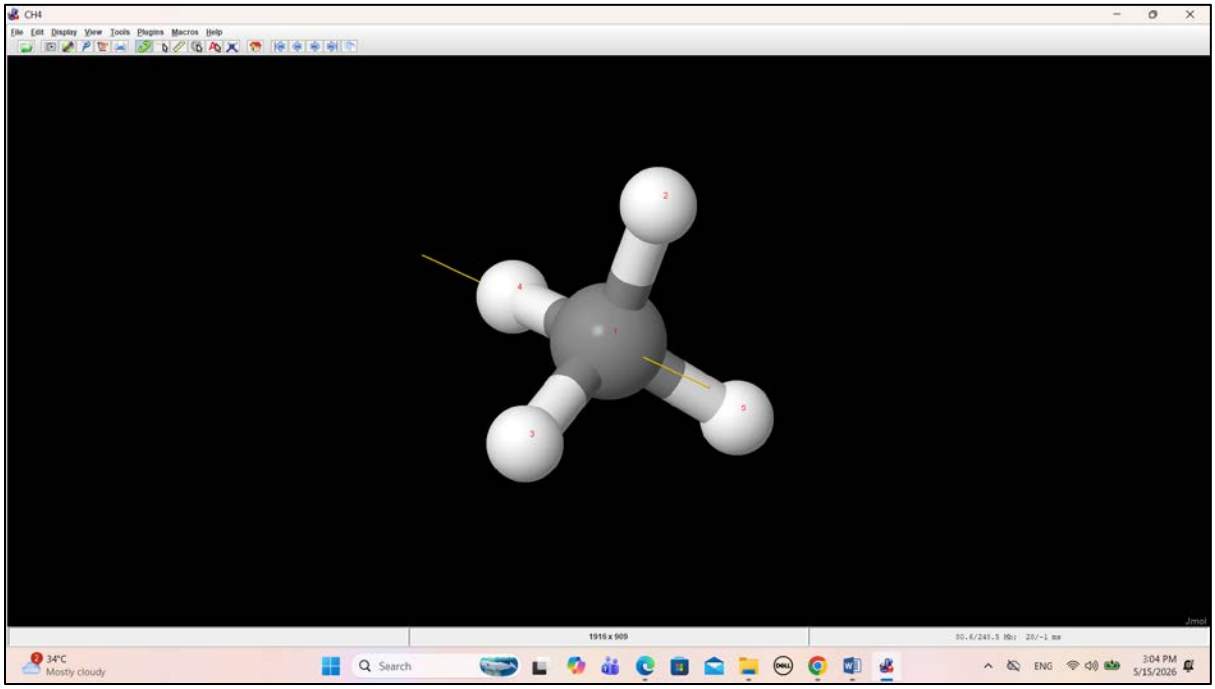

Figure 13: Visualization of C_3 axis of rotationof CH_4 in Jmol

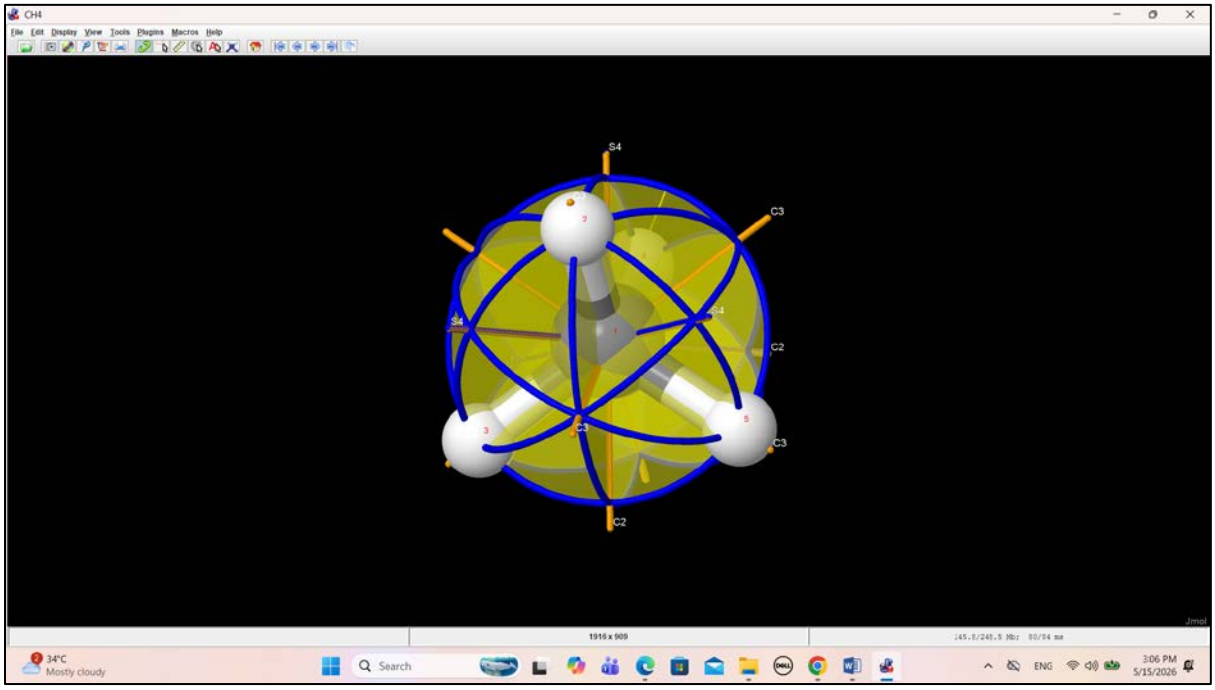

Figure 14: Visualization of allrotation and reflection symmetry elements of CH_4 in Jmol

Likewise, Symmetry@otterbein(symotter.org) can also be used to view molecules in 3D with animation for each symmetry elements present in a molecule and determine point group. Using the symmetry challenge option in symotter.org, for the same set of molecules in the Gallery, a flow chart showing the details of determining the point group of each molecule can be easily done by hands-on experience and it is found to a great and interesting way to practice the point group determination process. From the Symmetry gallery option in symotter.org, symmetry elements of the molecule to be determined are chosen and by clicking Operations and Symmetry Info tabs, user can view the structure with animation and number of symmetry elements present in it. For example, the structures obtained for the symmetry elements of chloromethane molecule(CH3Cl) from Operations and Symmetry Info tabs is given in Figures 12,13 and 14. Chloromethane molecule is chosen and the images of C3 rotational axis (Figure 12), □v (reflection/mirror) plane (Figure 13) and all the symmetry elements excluding Identity ((Figure 14) with point group of chloromethane and students can easily learn these symmetry elements with animation along with Vibrational representations.

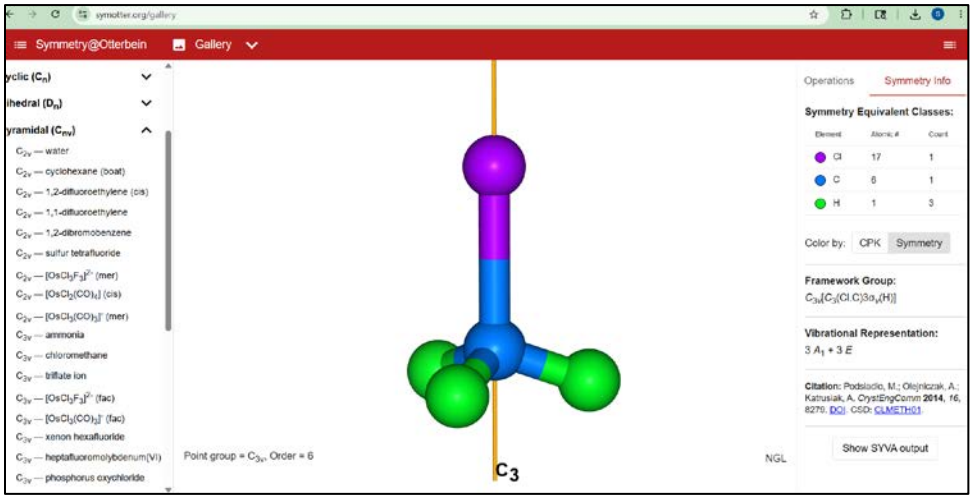

Figure 15: Structure of CH_3Cl showing C_3 axis of rotation visualized using Symmetry@Otterbein (symotter.org).

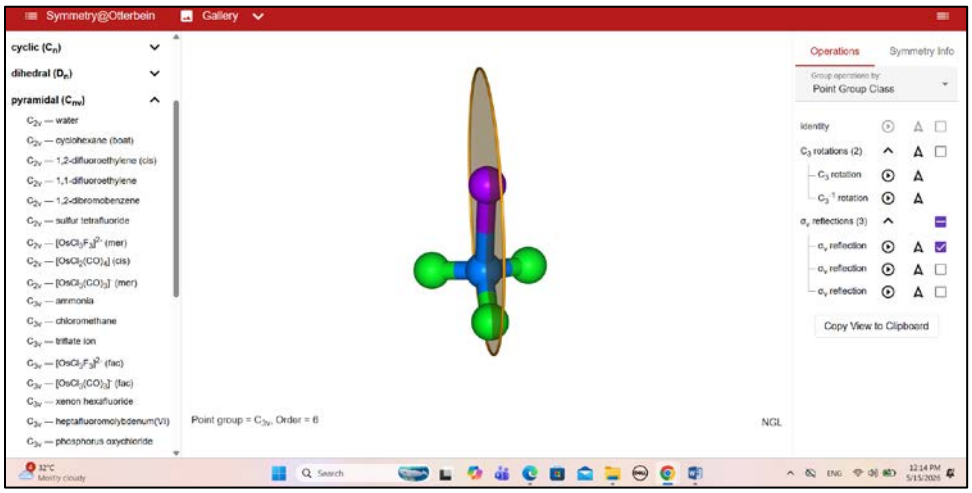

Figure 16: Structure of CH3Cl showing □v plane visualized using Symmetry@Otterbein (symotter.org).

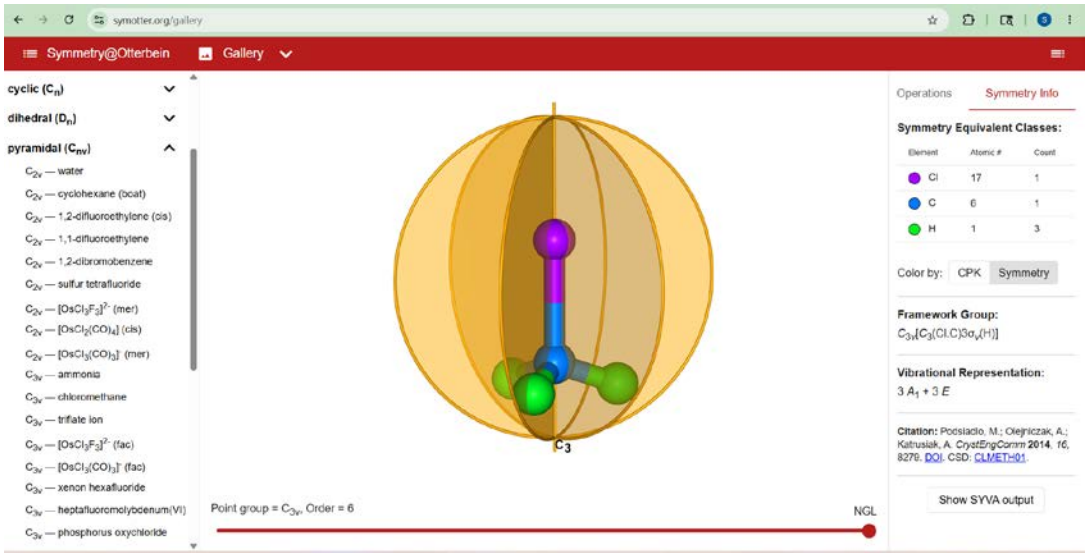

Figure 17: Structure of CH_3Cl showing C_3 axis of rotation and 3 σ_v planes visualized using Symmetry@Otterbein (symotter.org).

For explaining all symmetry elements in this paper, only images can be shown and 3D animation is not possible show since this paper is in 2. But while using the above three tools in class room, users can view the 3D image with animations in real time.Thus, by using these 3D visualization tools, teachers can transform their teaching pedagogy from passive lecturing to a dynamic, interactive, and student-centered approach, thereby fostering deeper understanding can make students to use these tools to determine the symmetry elements and point group of all molecules.

Conclusion

This paper demonstrates that the integration of ChemTube3D, Jmol and Symmetry@Otterbein(symotter.org) tools as 3D Visualization and animation Tools for teaching Symmetry concepts meaningfully in chemistry education by enhancing students' conceptual understanding. The use of these digital tools bridges the gap between symbolic representations and deeper conceptual understanding of symmetry elements by providing interactive 3D visualizations that allow users to actively manipulate molecular symmetry, overcoming the limitations of 2D diagrams. These findings highlight the importance of 3D visualization tools in Chemistry Education to promote active, dynamic, effective, constructive and interactive learning environment leading to improved learning outcomes and a more profound appreciation of Chemistry education.

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The Role of Language in Shaping Identity and Social Class: A Study of Pygmalion

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Abstract

Pygmalion by George Bernard Shaw as a significant text in the field of English Language Studies. The study focuses on how language functions as a powerful tool in shaping identity, social class, and personal transformation. Through the character of Eliza Doolittle, the play highlights the importance of pronunciation, accent, and linguistic competence in determining social mobility in society. The paper also examines the role of Professor Henry Higgins, whose phonetic training demonstrates the scientific and systematic nature of language learning. It connects the themes of the play with modern concepts in linguistics, such as sociolinguistics, phonetics, and language standardization. The transformation of Eliza from a flower girl to a refined speaker reflect show language education can influence both self-perception and societal acceptance. Furthermore, this study discusses the relevance of Pygmalion in contemporary English language teaching, especially in understanding accent bias, language attitudes, and communicative competence. The paper argues that the play remains a valuable resource for analyzing how language impacts power structures and identity formation. Pygmalion shows that language is not just a means of communication but a powerful tool for women's empowerment. Eliza's journey proves that mastering language helps women gain identity, challenge male dominance, and achieve equality in society. The paper discusses "Pygmalion" is not just a drama but a powerful study of language in society. It helps us understand that learning a language is not only about grammar, but also about identity, power, and social acceptance. Overall, this presentation aims to show that Pygmalion is not only a literary work but also an important text for understanding key concepts in English Language Studies.

Keywords: Language and Identity, Phonetics and Pronunciation, Sociolinguistics, Social Class and Mobility, Women's Empowerment

Introduction

Language has always served as more than a mere vehicle of communication; it is a social institution that encodes power, identity, and cultural belonging. George Bernard Shaw's Pygmalion (1913) offers a timeless dramatic exploration of this fundamental truth. Through the story of Eliza Doolittle, a Cockney flower girl transformed into a polished lady under the phonetic tutelage of Professor Henry Higgins, Shaw presents language as the primary determinant of social class and personal identity in British society. The play's central argument— that speech patterns, accent, and linguistic competence can radically alter an individual's social standing — resonates with contemporary sociolinguistic theory and remains profoundly relevant to modern English Language Studies.

In the contemporary era, language continues to be a marker of social distinction. Accent bias, linguistic discrimination, and the privileging of standard dialects over vernacular speech are well-documented phenomena in educational, professional, and social settings worldwide. Shaw's text, written over a century ago, anticipates these modern sociolinguistic realities with remarkable precision and therefore serves not only as a canonical work of English literature but also as an invaluable pedagogical resource for students and scholars of linguistics, education, and cultural studies.

Review of Related Literature

Pierre Bourdieu's concept of "linguistic capital" (1991) is particularly relevant here. Bourdieu argued that language is a form of capital exchangeable within social fields for economic, cultural, and symbolic rewards. Where a prestige dialect dominates, its speakers accumulate linguistic capital while speakers of stigmatized varieties are systematically disadvantaged — mapping directly onto Pygmalion, where Eliza's Cockney accent marks her as inferior and her acquisition of Received Pronunciation (RP) grants her access to elite social spaces. William Labov's pioneering work demonstrated that language variation is socially structured (1972). Speakers adjust their speech in response to social context and perceived prestige, a phenomenon Labov termed "style shifting." Eliza's transformation can be read as an extreme, pedagogically induced form of style shifting — moving permanently from a stigmatized variety to a prestige one.

Rosina Lippi-Green's English with an Accent (2012) argues that accent bias functions as a socially acceptable form of discrimination, allowing prejudice to be expressed under the guise of evaluating "professionalism." Shaw dramatizes this exact mechanism: Eliza is not evaluated on her intelligence or moral character, but solely on the quality of her vowels and consonants.

Robin Lakoff's Language and Woman's Place (1975) examined how women's language use is constrained by social norms and power structures. Eliza's situation exemplifies this constraint — taught to speak in a manner that pleases men, yet her linguistic empowerment ultimately enables her to assert autonomy. Feminist scholarship has emphasized this paradox: the tool used to subjugate Eliza ultimately becomes her instrument of liberation (Doan, 1994; Gainor, 1991).

Objectives

This paper investigates the multidimensional relationship between language, identity, and social class as depicted in Pygmalion. It explores how phonetic training and linguistic transformation function as mechanisms of social mobility, examines the ideological dimensions of standard versus non-standard language, and analyzes the gender dynamics embedded in the language education process. By connecting Shaw's literary vision to established frameworks in sociolinguistics, this study demonstrates that Pygmalion remains an essential text for understanding the intersection of language, power, and identity.

The objectives of this paper are fourfold: (1) to analyze how language acts as a determinant of social identity and class in Pygmalion; (2) to examine the role of phonetics and pronunciation in social transformation; (3) to connect Shaw's dramatic themes to modern sociolinguistic concepts; and (4) to evaluate the play's significance as a resource for understanding women's empowerment through linguistic agency.

Methodology

This study adopts a qualitative textual analysis approach, drawing on Shaw's Pygmalion, its preface, and his notes on phonetics. The analysis is situated within critical sociolinguistics, integrating Bourdieu's theory of linguistic capital, Labov's model of language variation and prestige, and feminist linguistic theory. The methodological approach involves close reading of key scenes and dialogues to identify instances where language mediates social interaction, identity performance, and power negotiation. Secondary sources include scholarly articles, critical essays, and linguistic studies relevant to accent, identity, social class, and language pedagogy.

Analysis

Language as Social Identity: The Cockney Accent and Its Consequences

From the opening scenes of Pygmalion, Shaw establishes the Cockney accent as a social stigma. When Higgins overhears Eliza speaking in Covent Garden, his immediate response is one of disgust and linguistic judgment: he identifies her dialect with precision and declares it a mark of degradation. This scene encapsulates Bourdieu's argument that linguistic capital is unequally distributed — Eliza possesses rich emotional and moral qualities, but her Cockney speech renders her invisible and valueless within the dominant social order.

Shaw uses the contrast between Eliza's dialect and the RP-accented speech of the middle and upper classes to dramatize what sociolinguists call "language ideology" — the set of beliefs and attitudes that associate certain language varieties with intelligence, education, and moral worth, and others with ignorance, vulgarity, and inferiority. Higgins's characterization of Eliza's speech as "depressing," and his boast that he could pass her off as a duchess, reveals the arbitrary nature of these ideological associations: the same person, with the same ideas and values, will be judged entirely differently based solely on her accent.

Phonetics, Pronunciation, and Social Mobility

Professor Higgins represents the scientific dimension of language, embodying the belief that speech is learnable, trainable, and ultimately separable from birth and natural identity. His phonetic laboratory, his records and charts, and his meticulous drilling of Eliza all reflect the empirical tradition of phonetics as developed by scholars like Alexander Melville Bell and Henry Sweet (on whom Higgins is partly modeled). Shaw's choice to centre the play's transformation on phonetics rather than vocabulary, grammar, or etiquette is deeply significant: it suggests that the most fundamental marker of social identity is not what one says, but how one sounds.

Eliza's training represents an extreme form of what modern sociolinguists call "language socialization" — the process by which individuals acquire not merely linguistic forms but the social meanings attached to those forms. As Eliza masters RP, she does not simply change her pronunciation; she internalizes a new social identity, learns to move differently, think differently, and perceive herself differently. This illustrates the profound psychosocial dimensions of language learning that go far beyond mere mechanical skill acquisition.

Language Standardization and Linguistic Ideology

The concept of "standard language ideology," as theorized by Lippi-Green (2012), holds that one variety of a language is inherently superior, more correct, and more beautiful than others. This ideology is fundamentally mythological — all language varieties are equally systematic and rule-governed from a linguistic standpoint — but it has immense social power. Pygmalion both critiques and illustrates this ideology. Shaw, himself deeply interested in phonetic reform and the democratization of English pronunciation, uses the play to expose the arbitrariness of linguistic prestige while simultaneously showing how real and consequential its effects are.

The famous garden party scene, where Eliza is initially accepted as a lady, and subsequently unmasked, illustrates the performative nature of linguistic identity. Identity, as Judith Butler (1990) would later theorize, is not a fixed essence but a performance, constituted through repeated acts. Eliza's new identity is a linguistic performance — fragile, contingent, and dependent on the ongoing maintenance of the right sounds and registers.

Gender, Language, and Power

The gender dynamics of Pygmalion are as significant as its class dynamics. Eliza's transformation is orchestrated entirely by men — Higgins conducts the experiment, Pickering provides funding and gentlemanly encouragement, and Freddy Eynsford-Hill ultimately adores the product — and Eliza herself is treated throughout much of the play as an object of linguistic experimentation rather than a subject with her own desires and agency.

However, the play's resolution complicates this picture. In Act Five, Eliza confronts Higgins with remarkable assertiveness, refusing to return to her position of dependence and demanding recognition as an equal. This confrontation is only possible because of her linguistic transformation: the very competence she has acquired gives her the tools to articulate her self-worth and challenge Higgins's authority. Language, in this sense, becomes the instrument of her emancipation. Eliza's journey demonstrates that linguistic capital, once acquired, cannot be entirely controlled by those who bestow it. The learner ultimately exceeds and escapes the intentions of the teacher.

Relevance to Contemporary English Language Teaching

Pygmalion raises urgent questions about the purpose of language education: Is it to help learners acquire a prestige variety, thereby improving social mobility? Or does such teaching implicitly endorse the devaluation of learners' native linguistic identities? These questions are central to current debates in ELT about World English’s, accent neutralization training, and communicative competence (Jenkins, 2000; Canagarajah, 2013).

Higgins represents a "deficit model" of language education, in which the learner's existing language is treated as something to be eradicated. Modern pedagogical theory rejects this in favor of approaches that value multilingualism, code-switching, and the learner's full linguistic repertoire. Read critically, Pygmalion helps contemporary students understand what is at stake — in terms of identity, dignity, and social justice — in decisions about language education policy.

Findings and Discussion

The analysis of Pygmalion through a sociolinguistic lens yields several significant findings. First, the play provides a remarkably accurate literary representation of the mechanisms by which language mediates social stratification, anticipating theoretical frameworks developed by Bourdieu, Labov, and Lippi-Green by decades. Second, the character of Eliza Doolittle illustrates the profound psychological dimensions of language learning, demonstrating that acquiring a new linguistic variety involves not merely skill development but identity reconstruction. Third, Professor Higgins's phonetic methodology reflects the scientific basis of language study while simultaneously exposing the ideological nature of standard language ideology. Fourth, the gender dynamics of the play reveal the double-edged nature of linguistic empowerment: language can be used as a tool of social control, but it can also become a means of resistance and self-assertion. Fifth, the play's themes connect directly to contemporary debates in ELT and sociolinguistics regarding accent bias, language attitudes, communicative competence, and the politics of standard language teaching.

Conclusion

Pygmalion is far more than a romantic comedy or a Cinderella story. It is a deeply considered examination of the relationship between language, identity, power, and society — a relationship that remains as complex in the twenty-first century as it was in Edwardian England. For students and scholars of English Language Studies, it offers an unparalleled literary case study in sociolinguistics, dramatizing concepts that remain at the forefront of the discipline. In a world where accent bias and linguistic discrimination continue to affect employment, education, and social inclusion, Shaw's text offers a timely reminder that language is never merely a technical matter — it is always a matter of identity, dignity, and power.

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Global Perspectives on Inclusive Education: Integrating Early Childhood and Special Education

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Abstract

This paper focuses on how important it is to give children quality education from a very young age. Early childhood is a key stage in a child's life because it helps in their mental, social and emotional development. At the same time special education is important to support children who have different learning needs and to make sure that no child is left behind. The presentation explains how inclusive education connects early childhood and special education where all children learn together in the same environment. It also looks at how different countries are trying to improve education and promote inclusion at a global level. It further discusses some common challenges like lack of trained teachers, limited resources and negative social attitudes towards children with special needs. It also talks about how educational technology can help make learning easier and more effective for all students. Overall, this presentation highlights the need for better policies, proper teacher training and global support to create an inclusive education system where every child gets equal opportunities.

Keywords: Early Childhood Development, Educational Technology, Global Education Policies, Inclusive Education, Special Education Needs (SEN)

Introduction

Education is a fundamental right for every child, regardless of their ability, background, or learning needs. Inclusive education has emerged as a global imperative that seeks to ensure all learners, including those with special educational needs (SEN), participate in mainstream educational settings. The integration of early childhood education (ECE) and special education within an inclusive framework is critical to promoting equity, social cohesion, and lifelong learning outcomes.

Early childhood, typically defined as the period from birth to eight years of age, represents a critical window of opportunity for brain development, socialization, and the formation of foundational skills. Research consistently demonstrates that early interventions, particularly for children with developmental challenges or disabilities, yield significant long-term benefits across cognitive, social, and emotional domains. When inclusive practices are embedded in early childhood settings, they create environments where diversity is valued and all children can thrive.

This paper examines global perspectives on inclusive education, with a focus on how early childhood education and special education can be effectively integrated. It analyses

existing frameworks, international policies, challenges, and the transformative role of educational technology in fostering inclusive learning environments worldwide.

Review of Related Literature

The literature on inclusive education has grown substantially over the past three decades, shaped significantly by international frameworks such as the Salamanca Statement (UNESCO, 1994), the Convention on the Rights of Persons with Disabilities (UN, 2006), and the Sustainable Development Goals (SDGs), particularly SDG 4, which calls for inclusive and equitable quality education for all. These frameworks have collectively advocated for the dismantling of segregated educational systems and the building of inclusive schools capable of meeting diverse learner needs.

Studies by Bronfenbrenner (1979) and Vygotsky (1978) underscore the importance of environmental factors and social interaction in early childhood development. These theoretical foundations support inclusive models where children with and without disabilities learn alongside each other. Friend and Bursuck (2018) note that early identification of special educational needs combined with responsive early childhood programming significantly improves developmental outcomes.

Globally, researchers have noted significant disparities in the implementation of inclusive practices. While countries like Finland, Canada, and New Zealand have made substantial progress in embedding inclusion within national education systems, many developing nations continue to face structural barriers. A review by UNESCO (2020) highlighted that teacher preparation, resource availability, and community attitudes remain the most persistent challenges to achieving meaningful inclusion.

Research Questions

This paper is guided by the following objectives:

- To examine the conceptual relationship between early childhood education and special education within inclusive frameworks.
- To analyse global policies and practices that promote inclusive education.
- To identify key challenges hindering the implementation of inclusive education.
- To explore the role of educational technology in supporting inclusive learning for all children.

The central research questions are:

- How can early childhood education and special education be meaningfully integrated to promote inclusive outcomes?
- What are the major barriers to inclusive education across different national contexts?
- How does educational technology contribute to bridging gaps in inclusive education systems?

Methodology

This paper adopts a conceptual and critical review methodology, drawing upon existing academic literature, international policy documents, and comparative case studies from multiple national contexts. A systematic literature review approach was employed, with sources identified through electronic databases including ERIC, Google Scholar, and

UNESCO's education repository. Inclusion criteria required that sources be peer-reviewed, published within the last two decades, and directly relevant to inclusive education, early childhood development, or special education needs.

The conceptual framework underpinning this paper draws on three theoretical pillars: (1) Bronfenbrenner's ecological systems theory, which situates child development within nested environmental contexts; (2) the Universal Design for Learning (UDL) framework, which advocates for flexible instructional design that accommodates diverse learners; and (3) the social model of disability, which locates barriers to participation in systemic and attitudinal structures rather than in the individual child.

Analysis

Connecting Early Childhood and Special Education

Inclusive early childhood education represents a convergence of two previously distinct fields. Early childhood education has historically focused on developmental milestones and play-based learning, while special education has concentrated on remediation and individualized support. Inclusive frameworks bring these traditions together, recognizing that all children benefit when educational environments are responsive to a range of learning profiles.

Early childhood settings that embrace inclusion demonstrate improved social competencies, language development, and academic readiness among all children. For children with SEN, inclusive early environments provide critical peer modelling, language-rich interactions, and normalized expectations that support holistic development.

Global Policies and Practices

Countries have adopted varying approaches to inclusive education, shaped by their socio-political contexts, resource availability, and cultural attitudes. In Scandinavia, strong social welfare systems and well-trained educators have facilitated high levels of inclusion. India's Right to Education Act (2009) mandates access for children with disabilities, though implementation gaps persist. In sub-Saharan Africa, limited infrastructure and high teacher-to-student ratios challenge the realization of inclusive ideals.

Comparative analysis reveals that nations with the most successful inclusive systems share common features: robust pre-service and in-service teacher training in special education, collaborative co-teaching models, strong family engagement, and adaptive curriculum frameworks that accommodate diverse learners.

Challenges to Inclusive Education

Several persistent challenges impede progress toward genuinely inclusive education systems:

- Shortage of trained teachers: Many educators lack adequate preparation in special education methodologies, differentiated instruction, or assistive technology use.
- Resource constraints: Inclusive education requires specialized materials, adapted facilities, and additional professional support, which are often unavailable in under-resourced settings.
- Attitudinal barriers: Negative social attitudes, including stigma, low expectations, and resistance from parents and educators, undermine inclusive initiatives.

- Policy-practice gaps: Even where inclusive policies exist, inconsistent implementation, monitoring, and accountability weaken their impact.

Educational Technology and Inclusive Learning

Educational technology holds significant promise for advancing inclusive education. Assistive technologies such as text-to-speech software, augmentative and alternative communication (AAC) devices, and screen readers enable children with physical or sensory disabilities to access the curriculum independently. Digital learning platforms can be customized to individual learning paces and styles, reducing the burden on teachers to simultaneously differentiate instruction for large, diverse groups.

Artificial intelligence-powered adaptive learning systems are increasingly being used to identify learning gaps in real time and adjust content delivery accordingly. In early childhood settings, interactive digital tools support language acquisition, early literacy, and numeracy development in engaging, multimodal formats. However, equitable access to technology remains a critical concern, with digital divides often mirroring existing inequalities.

Findings and Discussion

The review of global literature and policy documents reveals several key findings. First, inclusive early childhood education is most effective when implemented as part of a whole-school, whole-system approach rather than as an add-on or supplementary measure. Second, teacher attitudes and competencies are the strongest predictors of inclusive education quality; therefore, professional development must be continuous and embedded in practice.

Third, countries that have aligned early childhood and special education policies under a unified inclusion framework show better outcomes than those that treat the two fields separately. Fourth, educational technology, when accessible and appropriately used, meaningfully reduces barriers for children with SEN and supports teacher effectiveness. Fifth, family involvement is a critical but frequently overlooked component of successful inclusive education.

Conclusion

Inclusive education, particularly in the early childhood years, is not merely a policy aspiration but a practical necessity for equitable societies. This paper has demonstrated that the integration of early childhood and special education within inclusive frameworks is both theoretically sound and practically beneficial. The evidence from multiple global contexts underscores that inclusion works best when supported by strong policy commitments, well-prepared educators, flexible curricula, community engagement, and appropriate use of technology.

The implications of these findings are multi-layered. For policymakers, there is an urgent need to develop coherent national frameworks that align ECE and special education under a unified inclusion mandate. For teacher educators, pre-service and in-service programmes must be redesigned to equip all educators with the knowledge, skills, and attitudes necessary for inclusive practice. For researchers, further empirical studies are needed to evaluate the long-term outcomes of inclusive early childhood programmes across diverse cultural and economic contexts.

Ultimately, inclusive education is a shared responsibility that transcends national boundaries. Global collaboration, knowledge exchange, and sustained investment in inclusive systems are essential to ensure that every child, regardless of ability or background, has the opportunity to learn, grow, and contribute to society.

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Technology in Global Education: Opportunities, Challenges, and the Road Ahead

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Abstract

Technology is no longer a supplementary tool in education — it has become the very backbone of how learning is delivered, experienced, and assessed across the globe. This paper examines the broad landscape of technology in global education, exploring how digital innovations such as artificial intelligence, e-learning platforms, mobile learning, and virtual reality are reshaping classrooms in both developed and developing nations. The study draws on existing literature and documented evidence to assess the opportunities these technologies bring, the persistent challenges that limit their reach, and the policy directions that can ensure equitable adoption. Findings indicate that while technology holds enormous promise for personalizing and democratizing education, deep structural inequalities — particularly the digital divide — continue to prevent millions of learners from benefiting equally. The paper concludes that a multi-stakeholder approach involving governments, educational institutions, technology providers, and communities is essential to harness technology's full potential in global education.

Keywords: AI In Education, Digital Divide, Educational Technology, E-Learning, Global Education

Introduction

The relationship between technology and education is not new, but the pace at which it has evolved over the past two decades is unprecedented. From the introduction of personal computers in schools during the 1980s to the explosion of smartphones, cloud platforms, and artificial intelligence today, technology has continuously redefined what it means to teach and to learn. What makes the current moment particularly significant is the sheer scale and speed of this transformation — and its global reach.

Review of Related Literature

Globally, over 1.5 billion students were affected by school closures during the COVID-19 pandemic, forcing educational institutions to pivot almost overnight to remote and digital modes of instruction (UNESCO, 2020). This unprecedented disruption accelerated the adoption of digital tools across countries that had previously been slow to integrate technology into their education systems. In doing so, it exposed both the possibilities and the deep-seated inequities that technology in education can either bridge or widen, depending on how it is deployed.

In higher-income nations, students had relatively smooth transitions to online learning — equipped with devices, reliable internet, and teachers trained in digital pedagogy. In contrast, millions of students in low- and middle-income countries had little to no access to the internet or appropriate devices, leading to significant learning losses (World Bank, 2021). This stark contrast underscores the central tension in the discourse on technology and global education: technology is a powerful equalizer in theory, but its benefits are far from equally distributed in practice.

Objectives

This paper provides a broad overview of the role of technology in global education. It explores the major technological innovations currently transforming educational practice, analyses the benefits and challenges they bring, and discusses the implications for equity, policy, and the future of learning worldwide. The primary objective of this study is to synthesize key developments in educational technology and present a comprehensive picture of where global education stands today — and where it must head tomorrow.

Methodology

This study adopts a qualitative, descriptive research design grounded in documentary analysis. The methodology involves a systematic review of peer-reviewed journal articles, policy reports, institutional publications, and data from international organizations including UNESCO, the World Bank, the OECD, and the World Economic Forum. Sources were selected based on their relevance to technology integration in education at both national and global levels.

The review covered literature published primarily between 2015 and 2024 to ensure contemporary relevance, though foundational works from earlier decades were also referenced where appropriate. Thematic analysis was employed to identify recurring patterns, emerging trends, and key debates across the literature. Themes were organized around three broad areas: (1) the types of technology currently used in global education, (2) the benefits and outcomes associated with these technologies, and (3) the challenges and barriers to equitable adoption.

Secondary data was also drawn from global education statistics and reports to support the discussion with concrete evidence. The findings presented in this paper are therefore synthesized from multiple credible sources rather than from primary data collection, and the study acknowledges this as a limitation, recommending that future research incorporate primary empirical data across diverse geographic and socioeconomic contexts.

Findings and Discussion

Key Technologies Shaping Global Education

The review of literature reveals that several major technological categories are currently driving change in global education. Each of these presents distinct opportunities and challenges, and their level of adoption varies significantly across regions and institutional contexts. Table 1 summarizes the key technology areas identified in the literature along with their principal benefits, challenges, and current adoption levels.

Table 1: Key Technology Areas in Global Education — Benefits, Challenges, and Adoption Levels

Technology Area	Key Benefit	Major Challenge	Adoption Level
AI-Powered Adaptive Learning	Personalized instruction & feedback	High implementation cost	Moderate
MOOCs & Online Platforms	Wider global access to quality content	Low completion rates	High
Mobile Learning (mLearning)	Reach in remote/rural areas	Device & connectivity gaps	Growing
Virtual & Augmented Reality	Immersive, experiential learning	Infrastructure & teacher readiness	Emerging
Learning Management Systems (LMS)	Centralized course & assessment management	Resistance to adoption by educators	High
Blockchain for Credentialing	Tamper-proof, globally portable certificates	Regulatory and institutional acceptance	Low

Source: Author construct based on literature findings

Opportunities Brought by Technology in Education

Perhaps the most transformative opportunity technology offers education is personalization. Traditional classroom models operate on a one-size-fits-all approach, where a single teacher delivers the same content to students with vastly different backgrounds, learning speeds, and needs. Artificial intelligence and adaptive learning platforms break this mould by analyzing each learner's performance in real time and adjusting content, pacing, and difficulty accordingly (Holmes et al., 2022). Students who struggle with a concept receive more scaffolded support, while advanced learners are challenged with enriched material — all within the same classroom session.

Beyond personalization, technology has dramatically expanded access to quality education. Massive Open Online Courses (MOOCs) offered by platforms such as Coursera, edX, and Khan Academy have made courses from world-leading universities available to anyone with an internet connection, free or at a fraction of the traditional cost (Dillahunt et al., 2014). A student in rural India can attend a lecture by a professor at MIT; a young professional in sub-Saharan Africa can earn a professional certificate from a globally recognized institution. This democratization of knowledge, while still incomplete, represents a genuinely historic shift. Mobile learning has extended this reach even further. With mobile phone penetration far exceeding that of computers or fixed internet connections in many developing nations, smartphones have emerged as the primary learning device for millions. Platforms designed for mobile-first delivery, low-bandwidth environments, and offline access are making education reachable in communities where a traditional school infrastructure may be weak or absent (West & Vosloo, 2013).

Immersive technologies such as virtual reality (VR) and augmented reality (AR) are adding another dimension to learning. Medical students can practice surgical procedures in a virtual environment; history students can walk through ancient civilizations; engineering students can disassemble and reassemble virtual machinery. These tools make abstract concepts tangible and significantly enhance engagement and retention (Merchant et al., 2014). While

still largely confined to well-resourced institutions, the cost of VR hardware is declining, and its potential for widespread educational use is increasingly recognized.

Persistent Challenges and the Digital Divide

For all its promise, technology in education faces a set of deeply entrenched challenges that prevent it from fulfilling its transformative potential equitably. The most fundamental of these is the digital divide — the gap between those who have access to digital tools and the internet and those who do not. As of 2023, approximately 2.6 billion people worldwide still lacked internet access, most of them in low-income countries, rural areas, and marginalized communities (ITU, 2023). For these populations, the promise of digital education remains largely theoretical.

Even where devices and connectivity exist, the quality of access matters. A student with a slow, intermittent mobile data connection experiences online learning very differently from one with high-speed fibre broadband. Bandwidth-heavy content such as video lectures, interactive simulations, and collaborative platforms becomes inaccessible or frustrating under poor connectivity — effectively creating a second-tier digital education for those who are nominally 'connected' but inadequately so.

Teacher readiness is another significant bottleneck. Technologies are only as effective as the educators who deploy them. Across much of the world, teachers have received insufficient training in digital pedagogy — how to design online assessments, facilitate virtual discussions, use data from learning management systems, or integrate AI tools responsibly (Ertmer & Ottenbreit-Leftwich, 2010). Without investment in teacher professional development, even the most sophisticated EdTech tools risk being underutilized or misused. Privacy, data security, and algorithmic bias are also growing concerns. As educational platforms collect vast amounts of data on learners — their performance, behaviours, preferences, and even emotional states — questions arise about who owns this data, how it is used, and whether AI systems trained on biased datasets may inadvertently disadvantage certain groups of students. These are not merely technical questions; they are deeply ethical ones that policymakers, institutions, and technology developers must address together.

Technology has irrevocably altered the landscape of global education. It has expanded access, enabled personalization, enriched learning experiences, and connected learners and educators across geographic and cultural boundaries in ways that would have seemed remarkable just a generation ago. The evidence from global literature is clear: when technology is thoughtfully integrated, well-supported, and equitably distributed, it has the power to make education more effective, inclusive, and relevant to the demands of a rapidly changing world. Yet the same evidence is equally clear about the risks of an uncritical or unequal embrace of digital tools. The digital divide remains wide. Teacher capacity remains uneven. Data ethics remain under-regulated. And the risk that technology amplifies existing inequalities rather than reducing them is very real. A student with no device, no connectivity, and no digitally literate teacher is not merely behind she is being left further behind with every year that the digital transformation of education accelerates without including her.

Conclusion

The way forward demands intentional, multi-stakeholder collaboration. Governments must prioritize digital infrastructure investment alongside curriculum reform. Educational institutions must build teacher capacity for digital pedagogy as a matter of core professional development, not optional training. Technology developers must design with equity,

accessibility, and data responsibility at the centre, not as an afterthought. And international organizations must ensure that the global conversation about EdTech is genuinely global including the voices of those in low-income countries who have the most to gain and the least say in how these tools are designed and governed.

This study is based on secondary literature and acknowledges the need for empirical primary research particularly comparative studies across different national and institutional contexts to deepen understanding of what works, for whom, and under what conditions. Technology in global education is not a destination; it is an ongoing, evolving journey. How we navigate it will define the quality and equity of learning for generations to come.

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The Future of Global Education in a Digital and Connected World

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Abstract

The world is changing at a pace that few could have predicted even a decade ago, and education — the foundation of human progress — is changing alongside it. This paper explores the future of global education within the context of rapid digital transformation and an increasingly connected world. Drawing on a broad review of contemporary literature, international reports, and global data, the study examines how digital technologies are reshaping the structures, practices, and possibilities of education across diverse national and cultural contexts. The paper investigates key emerging trends including artificial intelligence, cloud-based learning systems, 5G connectivity, open educational resources, and immersive technologies, and considers how they will define the classroom of tomorrow. It also confronts the persistent challenges that stand between the promise of digital education and its equitable delivery — particularly the digital divide, teacher preparedness, data privacy, and institutional inertia. The study concludes that the future of global education will be shaped not merely by the technologies available, but by the collective choices societies make about who those technologies are built for, and whether access to them is treated as a right or a privilege.

Keywords: Digital Education, Educational Technology, Equity in Education Future of Learning, Global Connectivity

Introduction

We are living through one of the most consequential transformations in the history of education. The digital revolution, which began reshaping commerce, communication, and governance in the late twentieth century, has now arrived fully at the schoolhouse door. From primary classrooms in Finland to university lecture halls in Singapore, from mobile learning programmes in rural Kenya to AI-powered tutoring systems in South Korea, the tools and methods of education are evolving in ways that would have seemed extraordinary to previous generations.

At the heart of this transformation is connectivity. For the first time in history, it is technically possible — even if not yet practically realized — for a child anywhere in the world to access the same quality of educational content as a child in the most privileged institution in the world. The internet, mobile networks, and open digital platforms have dismantled, at least in principle, the geographic and economic barriers that once defined who could access high-quality learning. This is an extraordinary moment, and the decisions made today about how to develop, deploy, and govern educational technology will determine whether that potential is realized or squandered.

Yet alongside this optimism must sit a clear-eyed recognition of the gaps that persist. As of 2024, billions of people remain without reliable internet access. Teacher training systems in many countries are still preparing educators for classrooms of the past rather than the future. Curricula in numerous nations lag years behind the competencies the modern world demands. And the question of who benefits from digital education — and who is left further behind by it— remains urgently unanswered.

Review of Related Literature

Contemporary literature highlights that digital transformation is fundamentally reshaping global education through interconnected technologies and evolving pedagogies. Studies emphasize that teacher readiness, including knowledge, beliefs, and confidence, plays a crucial role in technology integration (Ertmer & Ottenbreit-Leftwich, 2010). International reports underline the rapid expansion of digital access, while also stressing persistent inequalities in connectivity and resources (ITU, 2023; World Bank, 2021). The growing role of artificial intelligence introduces both opportunities and ethical concerns, requiring responsible frameworks for implementation (Holmes et al., 2022; UNESCO, 2023). Furthermore, open educational resources and digital literacy are identified as key drivers of inclusive and flexible learning systems (Wiley & Hilton, 2018; OECD, 2021). Scholars also argue that the pandemic accelerated digital adoption, exposing systemic gaps in preparedness (UNESCO, 2020). Overall, the literature suggests that the future of education depends not only on technological advancement but also on equity, governance, and societal choices shaping access and participation.

Objectives

This paper examines the future of global education in a digital and connected world. It explores the major trends currently shaping that future, the challenges that must be overcome, and the principles that should guide policymakers, educators, and technology developers as they navigate this complex and critical terrain. The goal is not merely to describe what is happening, but to reflect on what should happen — and why it matters for every learner on the planet.

Methodology

This paper is based on a systematic qualitative review of secondary literature and documentary sources. The methodology follows an interpretive, descriptive approach suited to synthesizing complex, multi-dimensional topics across varied global contexts. Sources were drawn from peer-reviewed academic journals, policy documents, and reports published by leading international organizations including UNESCO, the World Bank, the OECD, the International Telecommunication Union (ITU), and the World Economic Forum.

The literature search focused on publications from 2015 to 2024 to ensure contemporary relevance, though seminal earlier works were included where they provided essential theoretical grounding. Search terms included combinations of phrases such as 'digital education,' 'future of learning,' 'educational technology,' 'global connectivity,' 'online learning,' 'AI in education,' and 'digital divide.' Thematic analysis was applied to organize the findings into coherent categories addressing trends, benefits, challenges, and policy implications.

Analysis

The study acknowledges its reliance on secondary sources as a primary limitation. While this approach allows for a comprehensive overview of a broad and evolving field, it does not capture the granular, context-specific nuances that primary empirical research across different nations and communities would provide. Future research building on this paper should incorporate primary data collection, including surveys, interviews, and case studies, from educators and learners across diverse socioeconomic and geographic contexts.

Findings and Discussion

Emerging Digital Trends Reshaping Global Education

The literature review reveals a clear and consistent set of digital trends currently reshaping education at the global level. These trends differ in their maturity, geographic penetration, and potential impact, but together they paint a picture of an educational landscape in profound transition. Table 1 summarizes the major trends identified across the literature, the contexts in

which they are most active, their impact on education, and the principal challenges associated with each.

Table 1: Key Digital Trends in Global Education — Context, Impact, and Challenges

Digital Trend	Region / Context	Impact on Education	Key Challenge
AI-Driven Personalization	Global (mainly HIC)	Adaptive, self-paced learning	Cost and infrastructure requirements
Cloud-Based LMS Platforms	Global	Anytime, anywhere access to courses	Unreliable internet in rural areas
5G & Broadband Expansion	Emerging economies	Faster real-time digital classrooms	Uneven rollout; affordability
Gamification & Immersive VR	Higher & secondary education	Deeper engagement and retention	Device scarcity and teacher readiness
Open Educational Resources (OER)	Global (especially LMIC)	Free access to quality curriculum	Content quality and language barriers
Blockchain Credentialing	Pilot programmes worldwide	Tamper-proof global qualifications	Low institutional trust and adoption

Source: Author construct based on literature findings (HIC = High-Income Countries; LMIC = Low- and Middle-Income Countries)

The Promise of a Digitally Connected Education Future

Perhaps the most profound promise of the digital transformation of education lies in its potential to break the link between geography and opportunity. For centuries, the quality of education available to a child was determined largely by where she was born — which country, which city, which neighbourhood, which family. Digital connectivity, in principle, severs that deterministic relationship. A student in a remote village with a reliable internet connection and a capable device can today access the same university lectures, interactive simulations, and global peer networks as a student at an elite institution in a capital city.

Artificial intelligence is adding a layer of personalization to this access that was previously impossible at scale. Adaptive learning systems can assess a student's current knowledge, identify gaps, adjust the difficulty and style of content in real time, and provide immediate, targeted feedback — functions that, in a traditional classroom, would require a dedicated tutor for each student. Research consistently shows that students learning with well-designed adaptive systems demonstrate improved outcomes, particularly those who have previously struggled in one-size-fits-all classroom environments (Holmes et al., 2022).

Connectivity also enables global collaboration in ways that enrich learning beyond what any individual classroom or curriculum can offer. Students in different countries can work on shared projects, compare historical narratives, debate cultural differences, and build relationships across national and linguistic boundaries. These experiences build the intercultural competencies, critical thinking skills, and collaborative habits of mind that the twenty-first century genuinely demands — and that no textbook alone can cultivate.

Open Educational Resources (OER) represent another dimension of this democratizing potential. Freely available, openly licensed educational content — from full university courses to individual lesson plans and assessment tools — means that curriculum quality need no longer be constrained by a school's budget. Educators in under-resourced settings can access, adapt, and share high-quality materials developed anywhere in the world, contributing to and drawing from a genuinely global commons of knowledge (Wiley & Hilton, 2018).

Persistent Challenges and the Risk of Widening Inequality

For all the promise it holds, the digital future of global education carries significant risks — chief among them the risk that it will deepen, rather than reduce, existing inequalities. The digital divide is not simply a matter of who has a device and who does not. It is a layered, systemic challenge encompassing access to hardware, reliable electricity, affordable broadband, digital literacy, and technically capable educators. In many low- and middle-income countries, all of these elements are simultaneously weak or absent, creating conditions in which even well-intentioned digital education initiatives fail to take root.

Teacher preparedness is a challenge that deserves particular emphasis, because technology in education is mediated almost entirely through human beings. A sophisticated learning management system in the hands of a teacher who does not understand how to use it pedagogically — how to design effective online tasks, facilitate digital discussions, interpret learning analytics, or support students experiencing digital exclusion — is of little educational value. Investing in teacher professional development is therefore not an optional complement to EdTech investment; it is a prerequisite for it (Ertmer & Ottenbreit-Leftwich, 2010).

Data privacy and algorithmic accountability are issues that will grow in urgency as AI becomes more deeply embedded in educational systems. Learning platforms collect vast quantities of data about students — their performance, engagement, learning pace, even emotional responses— and this data is increasingly used to make consequential decisions about instruction, assessment, and progression. Questions about who owns this data, how it is stored and shared, whether the algorithms that analyze it are free from bias, and what recourse students and families have when things go wrong are not merely technical

questions. They are matters of fundamental educational rights, and regulatory frameworks in most countries have not yet caught up with the technology (Selwyn, 2019).

There is also a deeper philosophical challenge embedded in the digital transformation of education: the risk of confusing access to information with genuine learning. Digital platforms can deliver content at massive scale, but content delivery is not the same as education. Learning requires reflection, dialogue, mentorship, struggle, and the cultivation of judgment — processes that are relational and deeply human. The most thoughtful approaches to digital education recognize this and seek to use technology to support and extend these human processes, not to replace them.

Policy Directions for an Equitable Digital Education Future

The literature points consistently toward several policy priorities that must be addressed if the future of global education is to be genuinely inclusive. First, infrastructure investment must be treated as an educational priority, not merely a telecommunication one. Universal broadband access, reliable electricity, and affordable devices are the physical prerequisites for digital education, and governments — supported by international development partners — must commit to providing them in underserved communities. Second, teacher education systems must be fundamentally reformed to prepare educators for digital classrooms. This means not only training teachers to use specific tools but developing their capacity for digital pedagogy — the ability to design learning experiences that use technology purposefully, critically, and in ways that serve the needs of diverse learners. It also means creating the conditions — including time, support, and professional community — for teachers to learn continuously as technology evolves.

Third, regulatory frameworks for data governance in education must be developed and enforced with genuine rigour. Students and families should have clear rights over educational data, and EdTech companies should be held to transparent standards of data use, algorithmic accountability, and equitable design. International cooperation will be essential here, given the cross-border nature of many digital education platforms. The future of global education in a digital and connected world is neither predetermined nor simply a matter of technological progress. It is a human and political project, shaped by the choices societies make about what education is for, who it is for, and what resources and rights they are willing to commit to making it genuinely available to all. The technologies exist today—or are rapidly emerging — to make education more personalized, more accessible, more engaging, and more globally connected than at any point in history. That is a genuine and remarkable opportunity.

But the same technologies, deployed without care, vision, or equity, could just as easily reinforce the hierarchies they promise to dismantle — making the already-advantaged more so, and leaving the already-marginalized further behind. The digital divide is real. The challenges of teacher preparedness, data governance, and algorithmic fairness are real. And the risk that the language of educational innovation becomes a cover for commercial interests rather than learner needs is also real.

Conclusion

What the evidence from the literature most clearly suggests is that technology alone will never be the answer to the complex challenges of global education. What matters — and what will ultimately determine whether the digital transformation of education fulfils its

promise — is the quality of human judgment, political will, and ethical commitment that shapes how those technologies are developed, governed, and used. The future of global education will be digital. Whether it will also be equitable, humane, and genuinely excellent is still very much up to us. This study, grounded in secondary literature, calls for continued primary empirical research across diverse national and institutional settings to deepen understanding of how digital transformation plays out in varied on-the-ground realities. Comparative studies across different income levels, geographic regions, and educational systems will be essential to building the evidence base that policymakers and practitioners need to navigate this transformation wisely.

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Spirituality and Education: A Pathway to Holistic Growth

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Abstract

Education in the twenty-first century is no longer confined to academic achievement and professional competence alone. Contemporary educational discourse increasingly emphasizes the importance of nurturing the emotional, moral, social, and spiritual dimensions of learners. Spirituality in education refers not merely to religious instruction but to the cultivation of meaning, purpose, compassion, self-awareness, interconnectedness, and inner peace. Holistic growth emerges when education addresses the complete development of an individual—mind, body, heart, and spirit. This article explores the relationship between spirituality and education, highlighting how spiritual values contribute to holistic development among students. The paper discusses theoretical perspectives, the role of spirituality in educational institutions, pedagogical practices promoting spiritual intelligence, challenges in implementation, and implications for higher education in the era of globalization and digitalization. The article concludes that integrating spirituality into education can foster ethical citizenship, emotional resilience, sustainable living, and humanistic leadership.

Keywords: Education, Holistic Growth, Holistic Development, Higher Education, Spiritual Intelligence, Spirituality, Value Education

Introduction

Sustainable Education has traditionally been associated with the transmission of knowledge, skills, and competencies necessary for economic productivity and social mobility. However, modern societies increasingly recognize that academic excellence alone cannot ensure human happiness, ethical conduct, or social harmony. Rising stress levels among students, emotional instability, moral decline, anxiety, violence, and excessive materialism reveal the limitations of purely cognitive education systems.

In response, educators and scholars advocate for a holistic educational paradigm that nurtures the intellectual, emotional, physical, social, and spiritual dimensions of learners. Holistic education views the learner as a complete human being rather than merely a recipient of information. Spirituality becomes central within this framework because it helps individuals discover meaning, purpose, connectedness, and self-realization.

Review of Related Studies

Recent studies emphasize that spirituality contributes significantly to students' well-being, empathy, mindfulness, emotional stability, and ethical consciousness. Research on holistic education identifies spirituality as an essential dimension of human development that should be consciously cultivated within educational environments.

The National Education Policy (NEP) 2020 in India also stresses value-based and holistic learning approaches that integrate ethics, critical thinking, empathy, and human values into educational systems. Spirituality in education, therefore, is increasingly viewed not as a religious agenda but as a transformative process fostering inner growth and societal responsibility.

Objectives

Spirituality is often misunderstood as synonymous with religion. However, spirituality in educational contexts transcends religious boundaries and refers to the inner search for meaning, authenticity, connectedness, compassion, and transcendence. It involves awareness of self and others, harmony with nature, ethical sensitivity, and reflective consciousness.

Scholars describe spirituality as the human capacity to seek purpose and interconnectedness with life and the universe. Holistic education frameworks emphasize spirituality as a universal human dimension that supports emotional maturity and ethical behaviour.

Spiritual education encourages learners to:

- Understand themselves deeply
- Develop empathy and compassion
- Cultivate mindfulness and emotional balance
- Build harmonious relationships
- Appreciate diversity and human dignity
- Seek meaning and purpose in life

Thus, spirituality in education is not indoctrination but transformation.

Methodology

Holistic Education: Meaning and Dimensions

Holistic education seeks the comprehensive development of learners by integrating multiple dimensions of personality. Unlike reductionist models focused only on academic achievement, holistic education emphasizes balanced human growth.

The major dimensions of holistic education include:

1. **Intellectual Development**

Development of critical thinking, creativity, analytical reasoning, and problem-solving abilities.

2. **Emotional Development**

Cultivation of emotional intelligence, self-regulation, empathy, and resilience.

3. **Social Development**

Enhancement of communication skills, cooperation, leadership, and social responsibility.

4. **Physical Development**

Promotion of health, fitness, discipline, and bodily well-being.

5. **Spiritual Development**

Nurturing inner peace, values, ethical awareness, mindfulness, and meaning in life.

Research in holistic education argues that spirituality functions as the integrating force connecting all dimensions of human growth.

Analysis

Theoretical Perspectives on Spirituality and Education

Humanistic Theory

Humanistic psychologists such as Abraham Maslow and Carl Rogers emphasized self-actualization, authenticity, and personal growth. Maslow's hierarchy of needs culminates in self-transcendence, highlighting spirituality as the highest stage of human development.

Holistic Education Theory

Thinkers such as Parker Palmer and Jack Miller argued that education should nurture the soul alongside the intellect. Holistic education emphasizes interconnectedness, ecological awareness, compassion, and inner transformation.

Contemplative Education

Contemplative education integrates mindfulness, meditation, reflective practices, and self-awareness into pedagogy. Studies indicate that contemplative practices improve concentration, emotional regulation, empathy, and psychological well-being among students.

Indian Philosophical Perspective

Indian educational traditions historically integrated spirituality with learning. Ancient Gurukul systems emphasized discipline, meditation, ethics, self-control, and harmony with nature. Philosophers such as Swami Vivekananda, Rabindranath Tagore, Sri Aurobindo, and Mahatma Gandhi advocated education aimed at character formation and spiritual awakening.

Findings and Discussion

Development of Moral Values

Spirituality strengthens honesty, integrity, compassion, humility, and ethical behavior. Students become more socially responsible and morally conscious.

Emotional Well-being

Spiritual practices such as mindfulness and meditation reduce stress, anxiety, and emotional instability. They improve emotional resilience and mental health.

Enhancement of Self-awareness

Spiritual education promotes introspection and self-understanding, enabling learners to recognize their strengths, weaknesses, aspirations, and emotions.

Promotion of Peace and Harmony

Students exposed to spiritual values develop tolerance, empathy, and respect for diversity, contributing to peaceful coexistence.

Building Meaning and Purpose

Spirituality helps learners understand the significance of life beyond material success and career achievement.

Sustainable and Ethical Living
Holistic spirituality encourages environmental consciousness, social justice, and sustainable lifestyles.
Research demonstrates that spiritual well-being positively influences students' holistic growth and educational experiences.

Pedagogical Practices for Spiritual Growth
Educational institutions can foster spirituality through various pedagogical approaches:

Mindfulness and Meditation
Mindfulness practices improve concentration, emotional stability, and awareness. Meditation enhances inner calmness and self-reflection.

Reflective Learning
Journaling, reflective discussions, and experiential learning encourage students to examine their values and experiences critically.

Value-Based Education
Curriculum integration of ethics, compassion, social responsibility, and character education strengthens moral development.

Arts and Creativity
Music, dance, storytelling, literature, and visual arts help learners express emotions and connect with deeper human experiences.

Nature-Based Learning
Outdoor education and environmental activities foster ecological sensitivity and interconnectedness with nature.

Community Service
Service-learning initiatives cultivate empathy, compassion, and civic responsibility.
Studies on contemplative education indicate that such approaches positively affect students' spiritual competence and emotional growth.

Spirituality in Higher Education

Higher education institutions increasingly recognize the importance of spiritual well-being in student development. Universities worldwide now incorporate mindfulness programs, counselling centres, ethics courses, yoga, and value-based learning initiatives. Indian higher education institutions are gradually adopting holistic education models aligned with NEP 2020. Recent literature reviews emphasize empathy, mindfulness, compassion, and reflective inquiry as essential dimensions of holistic higher education.
Spirituality in higher education contributes to:

- Leadership development
- Ethical decision-making
- Innovation and creativity
- Mental health support
- Social responsibility
- Global citizenship

Challenges in Integrating Spirituality into Education

Despite its significance, integrating spirituality into education faces several challenges.

Conceptual Ambiguity

Spirituality is often confused with religion, leading to resistance and misunderstanding.

Curriculum Constraints

Academic systems prioritize examinations and employability over value-based learning.

Lack of Teacher Training

Teachers may lack preparation to facilitate spiritual and reflective learning.

Commercialization of Education

Market-driven educational models focus heavily on competition and material success.

Cultural Diversity

Pluralistic classrooms require sensitive approaches that respect diverse beliefs and traditions.

Digital Distractions

Excessive technological engagement reduces opportunities for reflection, silence, and interpersonal connection.

Researchers note that successful implementation of holistic education requires institutional commitment, teacher readiness, and culturally adaptable pedagogical models.

Recommendations

To promote spirituality and holistic growth in education, the following measures are recommended:

- Integrate value-based and reflective learning into curricula.
- Provide mindfulness and emotional wellness programs in institutions.
- Train educators in holistic pedagogies and contemplative practices.
- Encourage experiential and service-based learning.
- Develop inclusive spiritual education frameworks respecting cultural diversity.
- Promote mental health awareness and emotional resilience initiatives.
- Incorporate arts, nature education, and ethical leadership programs.
- Align educational policies with sustainable human development goals.

Conclusion

Spirituality and education together create a transformative pathway toward holistic human development. In an increasingly fragmented and stressful world, education must move beyond information transmission to nurture compassionate, ethical, self-aware, and emotionally resilient individuals. Spirituality provides the inner foundation necessary for meaningful living, social harmony, and sustainable progress. Holistic education recognizes that true learning occurs when intellectual growth is harmonized with emotional maturity, moral consciousness, and spiritual awareness. By integrating spirituality into educational systems, institutions can cultivate not only competent

professionals but also responsible citizens and humane leaders capable of contributing positively to society.

The future of education lies not merely in technological advancement but in restoring the human spirit within learning environments. Spirituality in education thus emerges as a powerful catalyst for holistic growth, personal transformation, and global well-being.

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The Sovereign Classroom- A Comparative Framework for AI Governance and Economic Resilience in Global Higher Education

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Abstract

By 2026, Generative AI (GenAI) has matured into the foundational infrastructure for global knowledge. However, this transition has forced higher education into technological dependency on concentrated external providers. This research introduces the "Sovereign Classroom" framework to examine how the dichotomy between global monopolies and national data regulations redefines the economic competitiveness of academic institutions. The primary aim is to evaluate "asymmetric AI-dependency" where institutions rely on systems they neither own nor audit. We propose a multi-layered model for digital sovereignty that balances global innovation with the protection of localized intellectual property. Utilizing qualitative analysis of 2026 policy trends and institutional case studies, the research investigates how "black-box" algorithms threaten curriculum integrity and student privacy. A key finding is the emergence of "digital brain drain," where external entities extract localized research and teaching data, effectively eroding domestic labor market advantages and national strategic resilience. The discussion suggests that true competitiveness in the AI era depends on an institution's ability to host and govern its own intelligence ecosystems rather than remaining a passive consumer of biased platforms. This paper concludes that higher education leaders must pivot from procurement-based technology adoption to the strategic architectural design of sovereign digital environments. Such a shift is essential for ensuring long-term institutional sustainability, academic rigor, and the development of a workforce capable of navigating a fractured, AI-driven global economy. This research provides a critical roadmap for achieving that necessary goal.

Keywords: AI Governance, Algorithmic Hegemony, Digital Sovereignty, Economic Competitiveness, Higher Education Policy

Introduction

The academic landscape of 2026 is currently facing a silent crisis: universities have integrated Artificial Intelligence (AI) so deeply into their core infrastructure that they have effectively lost control over their own educational tools. While platforms like ChatGPT and Gemini have undeniably made student research faster and more efficient, this convenience has come at the cost of institutional autonomy, turning colleges into "digital tenants" who must follow the strict, non-negotiable rules of global private corporations. This state of "Asymmetric Dependency" is a major strategic risk because it places the future of our academic systems in the hands of outsiders who can change pricing, restrict access, or alter algorithms at any moment. Furthermore, a serious ethical

issue has emerged regarding the "harvesting" of original ideas; every time a student enters a research draft or a unique thought into a public AI tool, that data is extracted to train corporate models, leading to a massive loss of local intellectual property and student privacy. These global AI systems also suffer from "Algorithmic Hegemony," meaning they are trained on Western data and often fail to understand local laws, regional cultural nuances, or the specific requirements of our own syllabus. This lack of accuracy forces a generic, "one-size-fits-all" perspective on students that ignores their actual environment. This research argues that we can no longer afford to be passive consumers of external technology that does not respect our data or our culture. Instead, we must pivot toward the "Sovereign Classroom" a model where institutions host, manage, and govern their own private AI networks to ensure total data security and cultural relevance. By investigating current student trust and AI usage habits through a detailed survey, this study provides a necessary roadmap for colleges to reclaim their digital authority and build a truly self-reliant future in an increasingly fractured, AI-driven global economy.

Review of Related Literature

The Strategic Shift Toward AI Sovereignty

Recent research from the Brookings Institution (2026) defines AI sovereignty as a spectrum of strategies designed to enhance a country’s and its institutions capacity to make independent decisions about critical infrastructure. Scholars argue that as universities face rising dependence on a small number of global firms, they must seek agency over AI models to ensure cultural and linguistic inclusion. In Europe, alliances are increasingly embracing "open educational resources" to ensure teaching remains legally compliant and digitally sovereign.

Algorithmic Bias and Cultural Nuance

Recent studies highlight that global AI tools often fail to meet regional needs. Research published in Taylor & Francis (2025) indicates that AI in education (AIEd) can act as both a facilitator and a barrier, with variations in adoption often linked to specific cultural backgrounds and career types. Experts warn that automated tools trained on dominant Western norms can unintentionally disadvantage students from different linguistic or cultural backgrounds, especially in grading and feedback.

The Critique of Digital Colonialism

A major theme in 2025-2026 literature is "Digital Colonialism," where powerful tech giants exert power by taking data without clear consent. Critics argue that AI companies often treat public data as unclaimed data, scraping original student ideas to train models that are then sold back to the public. This insulates a "Hobson’s choice" for students: they must either agree to bundled data-sharing Institutional terms or face social and academic exclusion.

Trust and Data Governance

As of 2025, only 20% of higher education institutions had formal policies related to AI, though this number is rising as universities realize that blanket bans are unrealistic. EDUCAUSE (2025) findings suggest that effective governance requires moving beyond simple rules to creating "institutional infrastructure" like cross-functional task forces to ensure data privacy and ethical use.

The Socio-Economic Divide and AI Costs

New empirical evidence from April 2026 shows that while AI tools can reduce student expenditure on tutoring and materials by nearly 47%, this creates a "Digital Divide" for those who cannot access premium tools. Literature suggests that institutional integration of AI is essential to provide equitable, subsidized access, ensuring that financial status doesn't determine academic success in the AI era.

Objectives

To analyze the current level of academic dependency on third-party Artificial Intelligence platforms among undergraduate students.

- To evaluate student awareness regarding "Digital Sovereignty" and the implications of hosting educational data on foreign servers.
- To investigate the risks to Intellectual Property (IP) when students and faculty input original research into public, "harvesting" AI models.
- To identify the prevalence of "Algorithmic Bias" and the lack of regional, cultural, and syllabus-specific nuance in global AI outputs.
- To examine the "Black-Box" phenomenon in AI and its impact on the transparency and ethics of student learning processes.
- To assess the socio-economic impact of the "AI Divide," specifically how paid "Pro" subscriptions create inequality between different student groups.
- To measure the level of institutional trust students, place in their college versus global tech corporations regarding data custodianship.
- To explore the demand for a "Sovereign AI" ecosystem that is locally trained, institutionally managed, and aligned with the specific college curriculum.
- To determine the necessity of "Digital Self-Reliance" education as a mandatory component of the higher education syllabus in the AI era.
- To propose a strategic governance framework for the "Sovereign Classroom" that balances technological innovation with national and institutional autonomy.

1. Mail ID
2. Name
3. Age
4. Are you aware of the concept of "The Sovereign Classroom" in the context of AI in education?
   A. Yes, I am familiar with the term and its meaning.
   B. I have heard the term, but I am not sure what it involves.
   C. No, I have never heard of this concept before.

5.Before this survey, did you know that most AI tools (ChatGPT, Gemini) are owned by private companies outside our country?
   A) Yes, I was aware.
   B) I never really thought about it.

C) No, I didn't know.

6.Do you believe that an academic institution should have the authority to manage and host its own private AI network for students?

A) Strongly Agree (Universities should be independent)
B) Agree
C) Disagree (I prefer using public/global tools)
D) Strongly Disagree

7.How much of your weekly college assignments are done with the help of AI?

A) Almost all (75-100%)
B) More than half (50%)
C) Very little (Less than 25%)
D) I don't use AI at all

8.If AI tools like ChatGPT suddenly became unavailable, how would you feel?

A) Completely lost; I wouldn't know how to start my work.
B) Stressed, but I could eventually manage.
C) Fine; I prefer doing things manually anyway.

9.Have you ever noticed "Black-box" issues (where the AI gives an answer but you have no idea how it got there)?

A) Yes, and it’s frustrating.
B) I’ve noticed, but I don’t care as long as the answer is right.
C) I haven't noticed it

10.Do you feel that AI tools sometimes give "generic" answers that don't fit our local culture or syllabus?

A) Yes, very often
B) Sometimes
C) No, it feels accurate enough

11.When you type your original ideas into a public AI, are you worried the company might "harvest" your thoughts to train their system?

A) Yes, I worry about my intellectual property.
B) I’m a little worried, but I use it anyway.
C) No, I don’t think my data matters to them.

12.How much do you trust a global company (like OpenAI or Google) with your private academic data?

A) Full trust
B) Partial trust
C) No trust at all

13.If the college provided a "Sovereign AI" (a private tool managed locally and trained on your syllabus), would you use it?

A) Yes, it would be safer and more relevant to my exams.
B) Only if the public AI fails to answer.
C) No, I trust global platforms more.

14.Do you think "Digital Self-Reliance" (building our own AI tools and servers) is important for our country's future?

A) It is very important for national security and education.
B) It would be nice, but it’s not a priority right now.
C) No, we should just use what the rest of the world uses.

15.How important is it for you that your AI assistant understands regional nuances (like local laws, Tamil culture, or specific Indian economic trends)?

A) Extremely important for my field of study.
B) Somewhat important.

C) Not important; global perspectives are enough.

16.Do you agree that universities should move from being "Passive Consumers" of technology to "Active Creators" of their own digital environments?

A) Strongly Agree
B) Agree
C) Disagree
D) Strongly Disagree

17.On a scale of 1-5, how much do you trust your university to protect your digital data compared to a private tech company?

A) 1 (I trust the university much more)
B) 2
C) 3 (Neutral)
D) 4
E) 5 (I trust private tech companies much more)

18.Do you believe that "Sovereign AI" would reduce the risk of students getting biased or Western-centric information?

A) Yes, definitely.
B) Possibly, but it depends on how it is trained.
C) No, I don’t think it would change anything.

19.In opinion, should "Digital Sovereignty" be taught as a mandatory subject for all college students in the AI era?

A) Yes, we need to understand who controls our data.
B) It should be an optional seminar.
C) No, it is not necessary for my degree.
D) None

20.Do you think a locally-managed AI would help bridge the gap between students who can and cannot afford "Pro" AI subscriptions?

A) Yes, it provides equal, high-quality access to everyone.
B) Maybe, but the university might charge fees too.
C) No, it won't make a difference.

Methodology

Research methodology is a way to systematically solve a research problem. It is a science of studying how research is done. The researcher explains the methods and steps adopted for achieving the purpose of the study and to arrive at a meaningful conclusion.

A research design is the specification of methods and procedures for acquiring the information needed. It is the overall operation pattern or framework of the project that stipulates what information is to be collected, from which sources, and by what procedures. To examine **The Sovereign Classroom**, the study was conducted through a quantitative phase. The researcher used descriptive research design. The research instrument used is a questionnaire with closed-ended questions and multiple-choice questions designed to meet the purpose of the research. The data for the questionnaire was collected from the respondents.

Method of Data Collection

To accomplish the objectives of the study, both primary and secondary data were collected.

Primary Data
Primary data is the data which is collected. It is original in nature and is in the shape of raw material. To collect primary data, a well-structured questionnaire was filled by the respondents. The questionnaire comprises close-ended and multiple-choice questions.

Secondary Data
Secondary data is the data which is collected by someone else. It is secondary in nature and is in the shape of a finished product. Secondary data was collected so as to have accurate results. Required data was collected from various books, magazines, journals, newspapers, reports, and the internet.

Sampling Technique
The sampling technique used for the study is convenience sampling. This sampling is selected by the researcher for the purpose of convenience access.

Sample Size
For the study, a sample size of 100 respondents was selected.

Area of the Study
This study is limited to respondents (male and female) from various parts in Tamil Nadu.

The Sovereign Classroom Model
The conceptual framework of this study is built on the transition from Digital Dependency to Digital Sovereignty. It explains how academic institutions can move from being "tenants" of global tech companies to becoming "owners" of their own intellectual space. The framework is structured into three main pillars:

The Infrastructure Pillar (From Tenant to Owner)
Currently, universities operate as "digital tenants," relying on external cloud servers and proprietary software. The framework proposes a shift toward Institutional Hosting. By managing their own servers or private cloud networks, colleges can ensure that their digital tools remain active even if global providers change their terms, prices, or accessibility.

The Data Governance Pillar (From Harvesting to Protection)
A core part of this framework is the protection of Intellectual Property. In the current model, student and faculty data is "harvested" by public AI models. The Sovereign Classroom model creates a "closed-loop" system. In this system, data entered into the AI stays within the university’s firewall, ensuring that original research and private ideas are not used to train external corporate models without consent.

The Pedagogical Pillar (From Generic to Nuanced)
Global AI models often provide "one-size-fits-all" answers based on Western data. This framework introduces Contextual Training, where AI models are fine-tuned using the specific syllabus, local laws, and regional cultural nuances of the institution. This ensures that the AI provides accurate, relevant, and culturally sensitive academic guidance rather than generic information.

Analysis

The data has been collected from 100 respondents according to simple random sampling method. Data collection has been coded, tabulated, and analysed using SPSS.

A percentage is a way of expressing a number as a fraction of 100. It is used to show how much one quantity relates to another in terms of parts per hundred, making comparison easier. For example, 50% represents half of the total, while 100% represents the whole. Percentages are commonly used in statistics, reports, and data analysis to present information clearly and concisely.

Age of the Respondents

Age is an important factor in understanding how people choose insurance plans. It helps identify how different age groups perceive risk, plan, and select between term and endowment plans. Younger people often prefer term insurance for affordability, while older groups lean toward endowment plans for savings and security. This helps insurers design better products and awareness strategies for each age group.

Table 1. Age of the respondents

Age	Frequency	Percentage
17-19	27	27%
20-22	67	67%
23 Above	6	6%
TOTAL	100	100%

Source: Primary Data

Table 1 27% of the respondents are between 17-19 and 67% of the respondents are between 20-22 and 6% of the respondents are above 23. Hence, majority of the respondents are between 20-22.

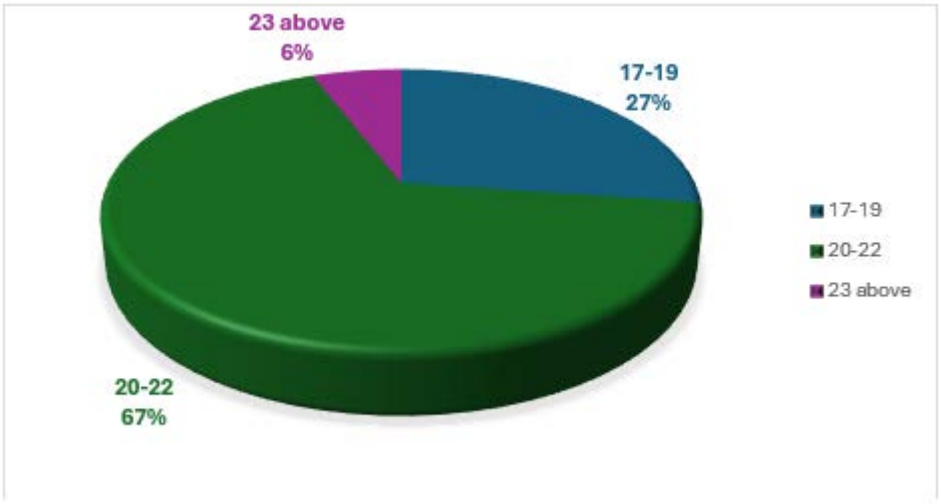

Figure 1: Age of the respondents

Aware of the concept of "The Sovereign Classroom" in the context of AI in education

Sovereign Classroom is an emerging concept in the context of AI in education. It refers to a classroom setup where the school has complete control over student data, AI tools, and curriculum without depending on external big tech companies. Teachers and institutions decide what AI can teach, how data is stored, and what content is allowed. This concept is

important because it ensures data privacy, local culture alignment, and academic freedom. Studying awareness levels helps us understand whether students and teachers are ready to adopt self-controlled AI systems in education.

Table 2 Aware of the concept of "The Sovereign Classroom" in the context of AI in education

Particulars	Frequency	Percentage
Yes	35	35%
Maybe	43	43%
No	22	22%
Total	100	100%

Source: Primary Data

Table 2 35% of the respondents are Yes and 43% of the respondents are Maybe and 22% of the respondents are No. Hence the majority of the respondents may be.

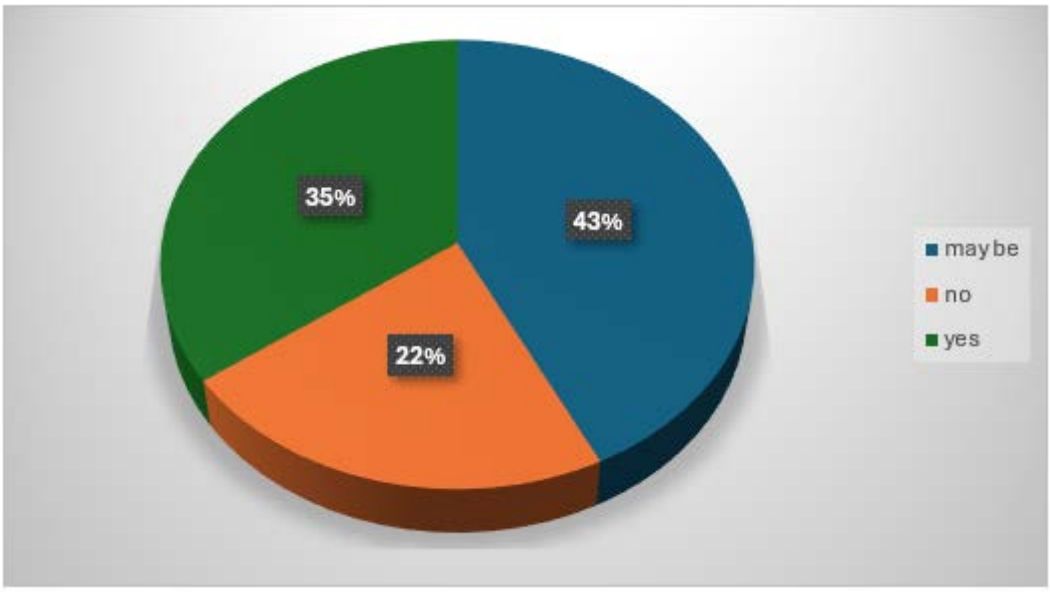

Figure 2: Aware of the concept of "The Sovereign Classroom" in the context of AI in education

AI tools are owned by the private company outside our country

The ownership of AI tools is a major concern in the concept of Sovereign Classroom. When AI tools used in education are owned by private companies outside the country, student data, learning patterns, and classroom activities may be stored in foreign servers. This raises issues related to data privacy, national security, and cultural bias. If the AI is controlled by external companies, schools lose the freedom to decide what content should be taught or blocked. Studying the respondents' opinion on this helps understand the need for locally owned, sovereign AI systems in education.

Table 3 AI tools are owned by the private company outside our country

Particulars	Frequency	Percentage
Yes, I was aware	66	66%
Yes, some	25	25%
No, I didn't know	9	9%
Total	100	100%

Source: Primary Data

Table 3 66% of the respondents are Yes, I was aware and 25% of the respondents are Yes, some and 9% of the respondents are No, I didn't know. Hence the majority of the

respondents are yes, I was aware.

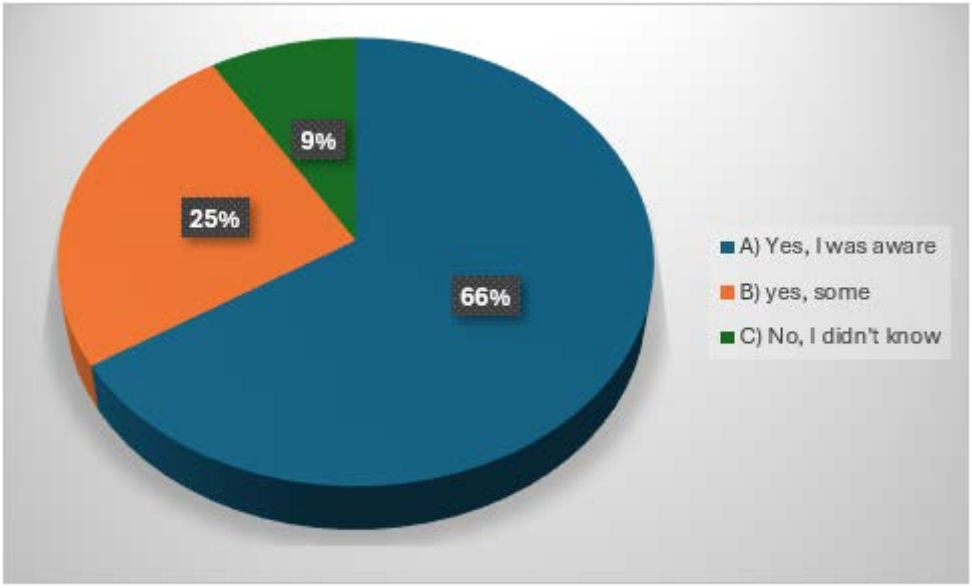

Figure 3: AI tools are owned by a private company outside our country

AI tools became unavailable

One of the key risks in depending on external AI tools for education is their sudden unavailability. Many schools use AI platforms owned by foreign companies that can withdraw services, increase prices, or block access due to policy changes. This affects continuous learning and disrupts classroom activities. In a Sovereign Classroom setup, the institution owns and controls its AI tools, ensuring that availability is not dependent on third-party decisions. Studying respondents' experience with AI tools becoming unavailable helps highlight the need for self-reliant AI systems in education.

Table 4 AI tools became unavailable

Particulars	Frequency	Percentage
Completely lost	24	24%
Stressed	51	51%
Fine	25	25%
Total	100	100%

Source: Primary Data

Table 4 24% of the respondents are Completely lost and 50% of the respondents are Stressed and 25% of the respondents are Fine. Hence the majority of the respondents are Stressed.

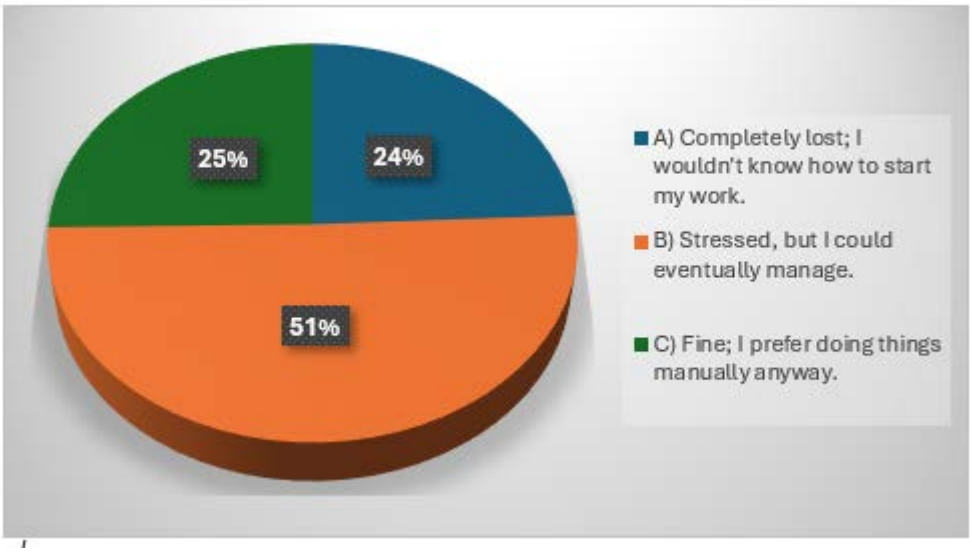

Figure 4: AI tools became unavailable

Ever noticed black box issue

The "Black Box" issue refers to the lack of transparency in how AI tools make decisions or generate answers. Users input data and get output but cannot see or understand the logic behind it. In education, this becomes a problem because teachers and students cannot verify why the AI gave a particular answer, marked something right or wrong, or suggested specific content. In a Sovereign Classroom, the goal is to use open and explainable AI models where schools can audit the process. Studying whether respondents have noticed this black box issue shows the level of transparency awareness among AI users in education.

Table 5 Ever noticed black box issue

Particulars	Frequency	Percentage
Yes, and it's frustrating	35	35%
I've noticed but I don't care as long as the answer is right	41	41%
I haven't noticed this	24	24%
Total	100	100%

Source: Primary Data

Table 5 35% of the respondents are Yes, and it's frustrating and 41% of the respondents are I've noticed but I don't care if the answer is right and 24% of the respondents are I haven't noticed this. Hence the majority of the respondents are I've noticed but I don't care as long as the answer is right.

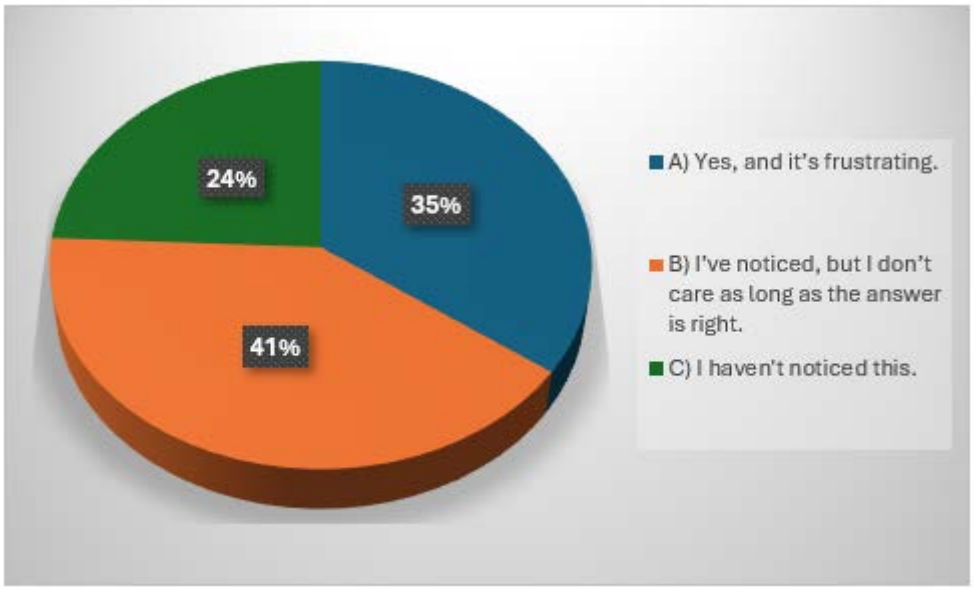

Figure5: Ever noticed black box issue

AI tools sometimes give generic answers

AI tools in education is that they sometimes provide generic or irrelevant answers. Since most global AI models are trained on western data, they may not understand local syllabus, culture, or context-specific questions. This reduces the usefulness of AI in classrooms because students get surface-level answers instead of syllabus-focused explanations. In a Sovereign Classroom, AI models can be fine-tuned on local textbooks and curriculum to give specific, accurate answers. Studying respondents' opinions on this issue helps understand the need for customized AI in education.

Table 6 AI tools sometimes give generic answer

Particulars	Frequency	Percentage
Yes, very often	38	38%
Sometimes	60	60%
No, it feels accurate enough	2	2%
Total	100	100%

Source: Primary Data

Table 6 38% of the respondents are Yes, very often and 60% of the respondents are Sometimes and 2% of the respondents are No, it feels accurate enough. Hence most of the respondents are Sometimes.

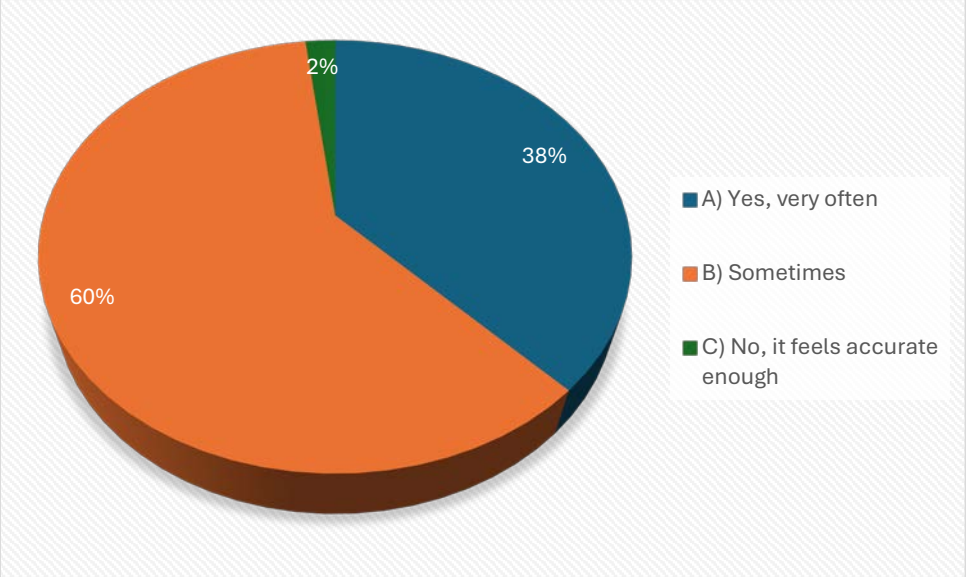

Figure 6: AI tools sometimes give generic answer

Are you worried about the company might "harvest" your thoughts to train their system

AI tools owned by external private companies. When students or teachers use these tools, their prompts, answers, learning behavior, and personal details may be collected and stored by the company. This data can be used for commercial purposes, advertising, or even sold to third parties without consent. In a Sovereign Classroom setup, student data stays within the school's server and is not shared externally. Studying respondents' worry about data harvesting helps understand the importance of data privacy and the need for locally controlled AI systems.

Table 7 Are you worried about the company might "harvest" your thoughts to train their system

Particulars	Frequency	Percentage
Yes, I worry about my intellectual property	27	27%
I'm a little worried but I use it anyway	64	64%
No, I don't think my data matters to them	9	9%
Total	100	100%

Source: Primary Data

Table 7 27% of the respondents are Yes, I worry about my intellectual property and 64% of the respondents are I'm a little worried but I use it anyway and 9% of the respondents are No, I don't think my data matters to them. Hence the majority of the respondents are I' m a little worried but I use it anyway.

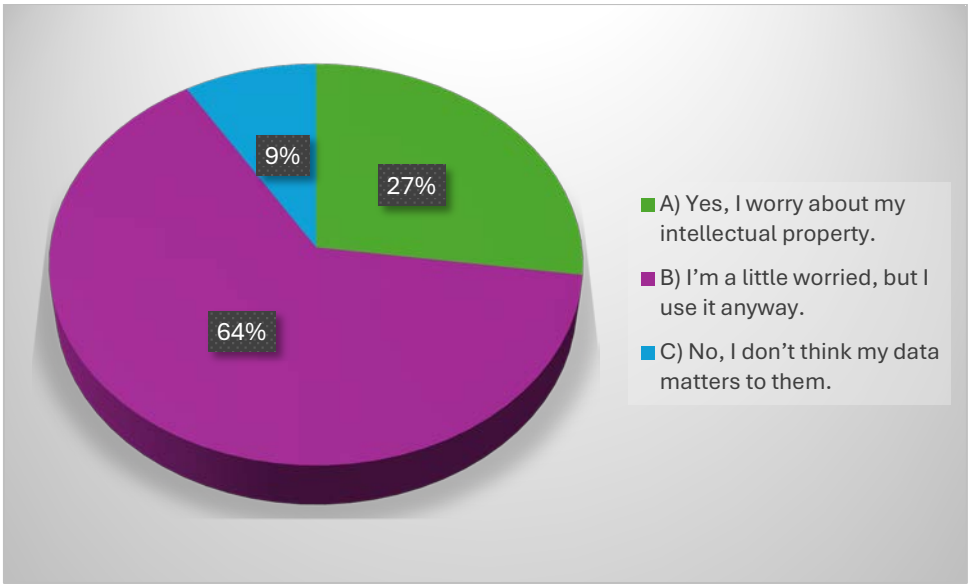

Figure 7: Are you worried about the company might "harvest" your thoughts to train their system

If the college provided a "Sovereign AI"

AI tools is crucial for building a Sovereign Classroom environment. When colleges themselves provide AI tools instead of relying on external free apps, they can ensure data security, curriculum alignment, and continuous access. College-owned AI systems can be customized for the syllabus, run on local servers, and protect student data from third-party harvesting. Studying whether colleges provide AI tools helps measure the current adoption level of institutional-level AI and the readiness for sovereign AI infrastructure in education.

Table 8 If the college provide a "Sovereign AI"

Particulars	Frequency	Percentage
Yes, it would be safer and more relevant to my exams	58	58%
Only if the public AI fails to answer	37	37%
No, I trust global platforms more	5	5%
Total	100	100%

Source: Primary Data

Table 8 58% of the respondents are Yes, it would be safer and more relevant to my exams and 37% of the respondents are Only if the public AI fails to answer and 5% of the respondents are No ,I trust global platforms more. Hence the majority of the respondents are Yes, it would be safer and more relevant to my exams.

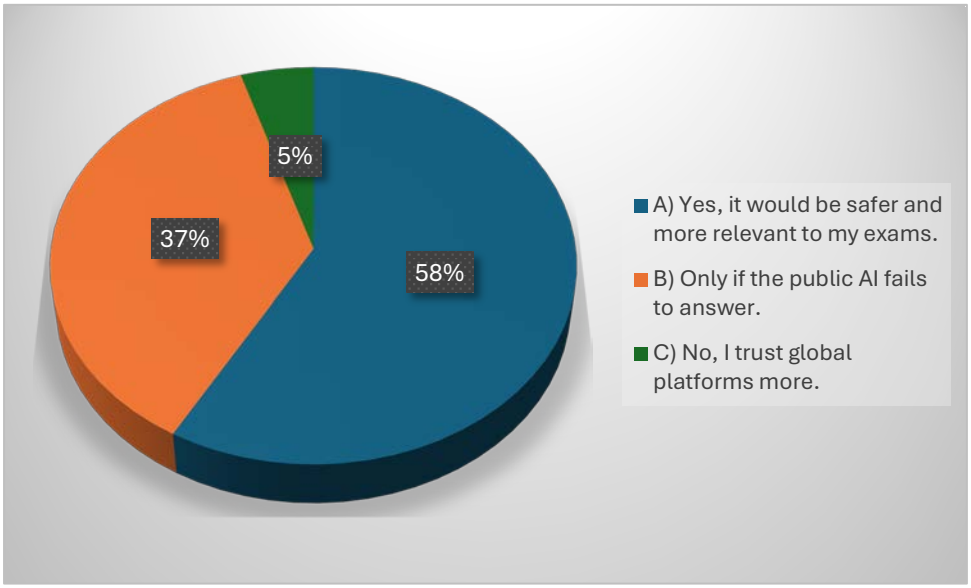

Figure 8: If the college provide a "Sovereign AI"

Digital self-reliance

Digital Self-Reliance means the ability of an institution or country to develop, own, and control its own digital tools without depending on foreign companies. In the context of AI in education, it refers to schools and colleges using locally developed or college-owned AI models instead of relying on external platforms like Chat GPT or Gemini. This ensures data stays within the country, content aligns with local syllabus, and access is not blocked by foreign policy changes. Digital self-reliance is the core principle of a Sovereign Classroom. Studying respondents' opinion on this shows how much they support independent AI systems in education.

Table 9 Digital self-reliance

Particulars	Frequency	Percentage
It is very important for national security and education	56	56%
It would be nice, but it's not a priority right now	39	39%
No, we should just use what the rest of the world uses	5	5%
Total	100	100%

Source: Primary Data

Table 9 56% of the respondents are It is very important for national security and education and 39% of the respondents are It would be nice, but it's not a priority right now and 5% of the respondents are No, we should just use what the rest of the world uses. Hence the majority of the respondents are Yes, it would be safer and more relevant to my exams.

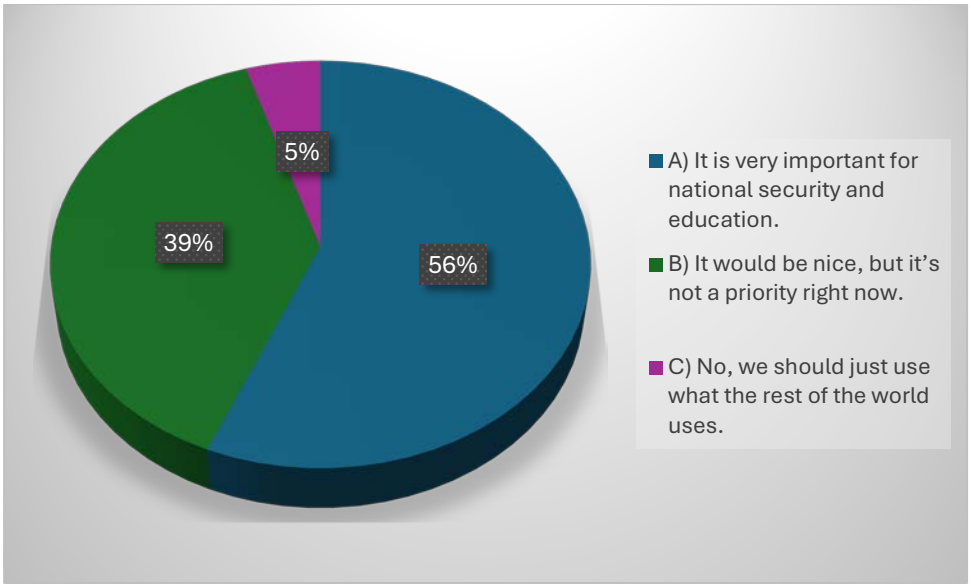

Figure 9: Digital self-reliance

AI understood regional nuances

Regional nuances refer to local language, culture, examples, syllabus, and context that are specific to a particular state or country. Most global AI tools are trained mainly on western data and struggle to understand Tamil syllabus, Indian examples, or local cultural references. Because of this, students often get answers that are not relevant to their textbooks or exams. In a Sovereign Classroom, AI models can be fine-tuned with regional data so that they understand local nuances and give accurate, context-specific answers. Studying respondents' opinion on whether current AI tools understand regional nuances helps justify the need for localized AI in education.

Table 10 AI understood regional nuances

Particulars	Frequency	Percentage
Extremely important for my field of study	50	50%
Somewhat important	41	41%
Not important; global perspectives are enough	9	9%
Total	100	100%

Source: Primary Data

Table 10 50% of the respondents are Extremely important for my field of study and 41% of the respondents are Somewhat important and 9% of the respondents are Not important; global perspectives are enough. Hence the majority of the respondents are Extremely important for my field of study

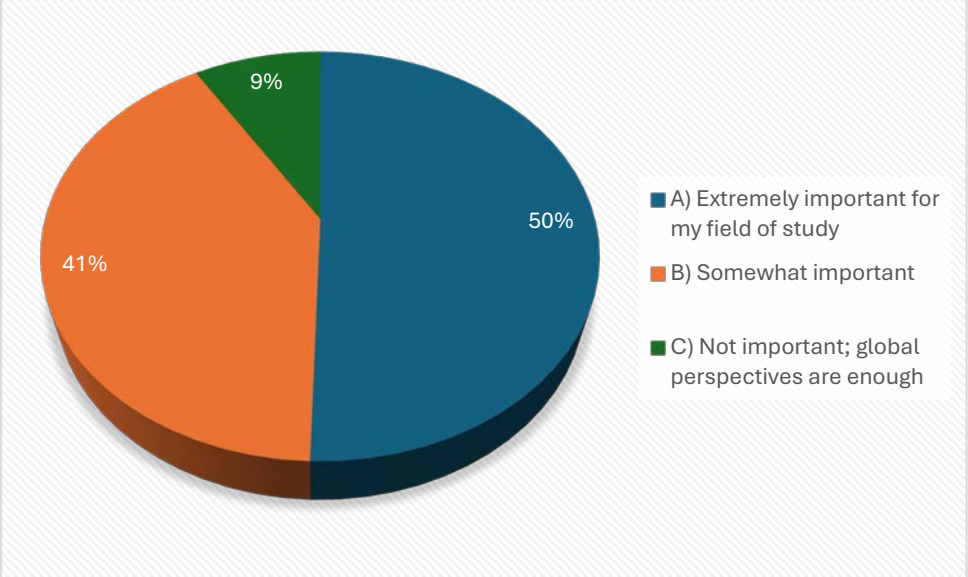

Figure 10: AI understood regional nuances

Sovereign AI would reduce the risk of students

AI in education is to reduce risks faced by students while using external AI tools. When students use foreign AI platforms, their personal data, learning behavior, questions, and assignments may be stored on external servers. This creates risks like data harvesting, profiling, privacy breaches, and exposure to inappropriate content that cannot be controlled by the school. Sovereign AI runs on college-owned or local servers where the institution has full control over data and content filtering. This reduces the risk of student data misuse and ensures a safe learning environment. Studying respondents' opinion on this shows how much they trust sovereign AI for student safety.

Table 11 Sovereign AI would reduce the risk of students

Particulars	**Frequency**	**Percentage**
Yes, definitely	24	24%
Possibly, but it depends on how it is trained	68	68%
No, I don't think it would change anything	8	8%
Total	100	100%

Source: Primary Data

Table 11 24% of the respondents are Yes, definitely and 68% of the respondents are Possibly, but it depends on how it is trained and 8% of the respondents are No, I don't think it would change anything. Hence the majority of the respondents are Possibly, but it depends on how it is trained.

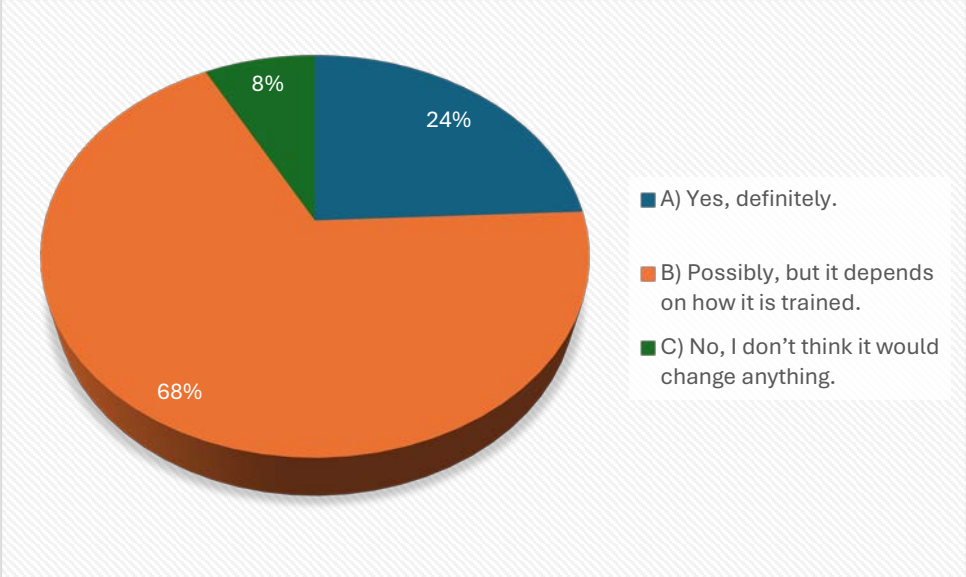

Figure 11: Sovereign AI would reduce the risk of students

Digital sovereignty for all college students in the AI Era

Digital sovereignty in the AI era means giving college students the right to use AI tools that are controlled, owned, and managed within their own country or institution. It ensures that students' learning data, academic work, and personal information are not controlled by foreign companies. When students have digital sovereignty, they can access AI that respects local values, syllabus, and privacy laws. This also protects them from sudden bans, price hikes, or censorship by external platforms. In a Sovereign Classroom, digital sovereignty guarantees that every college student gets safe, unbiased, and uninterrupted access to AI. Studying respondents' opinion on this shows the demand for equal and secure AI access for all students.

Table 12 Digital sovereignty for all college students in the AI Era

Particulars	Frequency	Percentage
Yes, we need to understand who controls our data	46	46%
It should be an optional seminar	39	39%
No, it is not necessary for my degree	13	13%
None	2	2%
Total	100	100%

Source: Primary Data

Table 12 46% of the respondents are Yes, we need to understand who controls our data and 39% of the respondents are It should be an optional and 13% of the respondents are No, it is not necessary for my degree and 2% of the respondents are option. Hence the majority of

the respondents are Yes, we need to understand who controls our data.

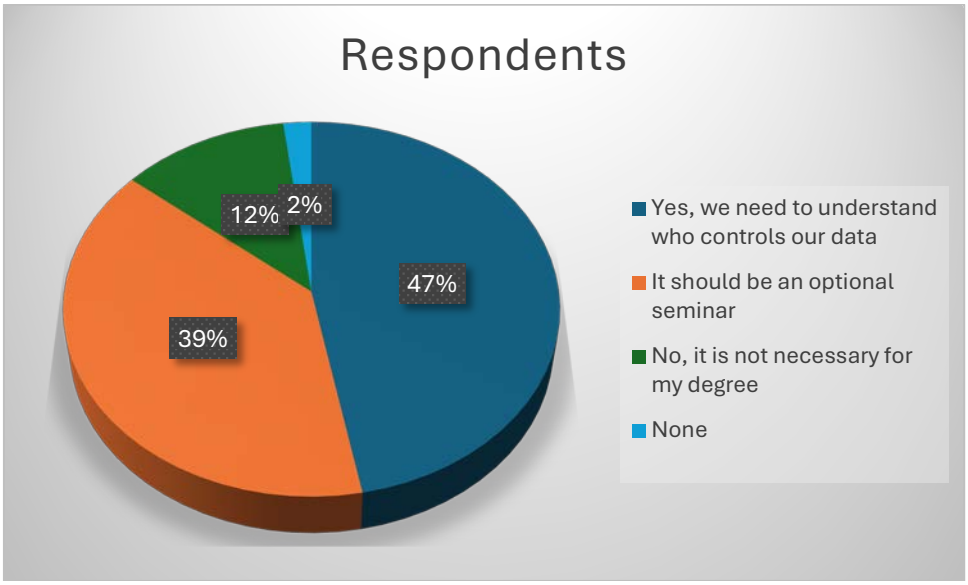

Figure 12: Digital sovereignty for all college students in the AI Era

AI would help bridge the gap between students

AI in education has the potential to reduce inequality among students. Currently, students from urban areas or private colleges have better access to quality teaching, resources, and technology compared to rural or government college students. AI tools can provide personalized learning, 24/7 doubt solving, and syllabus-based explanations to all students equally. In a Sovereign Classroom, locally trained AI can deliver content in regional languages and match the local syllabus, ensuring that every student gets the same quality of support. This helps bridge the gap between students from different economic, social, and geographical backgrounds. Studying respondents' opinion on this shows how much they believe AI can create equal learning opportunities.

Table 13 AI would help bridge the gap between students

Particulars	Frequency	Percentage
Yes, it provides equal high-quality access to everyone	50	50%
May be, but the university might charge fees too	42	42%
No, it won't make a difference	8	8%
Total	100	100%

Source: Primary Data

Table 13 50% of the respondents are Yes, it provides equal high-quality access to everyone and 42% of the respondents are May be, but the university might charge fees too and 8% of

the respondents are No, it won't make a difference. Hence the majority of the respondents are Yes, it provides equal high-quality access to everyone.

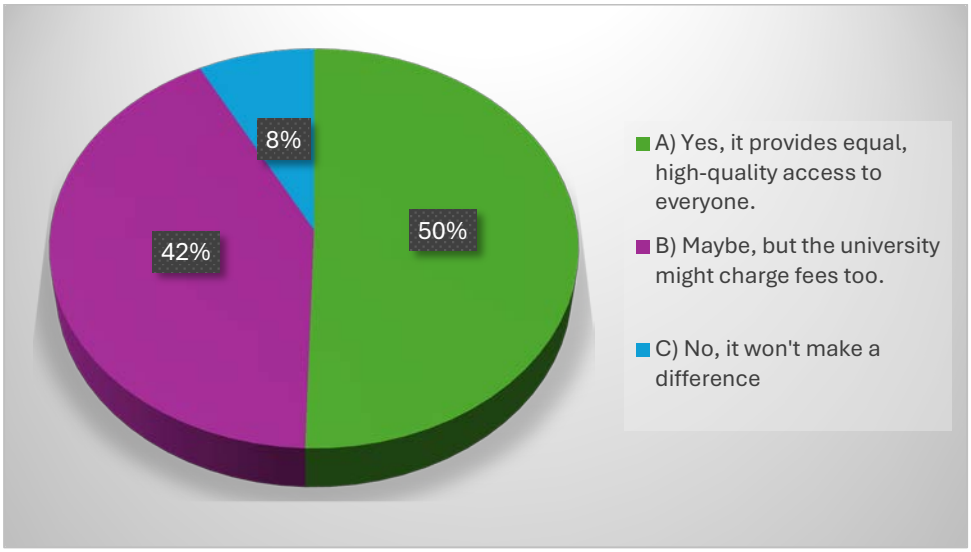

Figure 13: AI would help bridge the gap between students

Findings and Discussion

CHI-SQUARE Test

The Chi-square test is a statistical method used to check whether there is a relationship between two variables. It helps researchers compare actual data with expected data. This test is commonly used in surveys and research analysis. If the calculated value is high, it shows there may be a significant difference or association. Chi-square is mainly used for categorical data such as gender, age group, or choices.

Analysis of Students' Views on "Passive Consumers" vs "Active Creators" and Digital Data Trust:

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
1.On a scale of 1 to 5, who do you trust more to protect your academic and personal data? * 2. Do you agree that universities should move from being "Passive Consumers" of technology to "Active Creators" of their own digital environments?	104	100.0%	0	0.0%	104	100.0%

1.On a scale of 1 to 5, who do you trust more to protect your academic and personal data? * 2.Do you agree that universities should move from being "Passive Consumers" of technology to "Active Creators" of their own digital environments? Crosstabulation

Count

		2.Do you agree that universities should move from being "Passive Consumers" of technology to "Active Creators" of their own digital environments?							
			A) Strongly Agree	Agree	Disagree	Neutral	Strongly agree	Strongly disagree	Total
1.On a scale of 1 to 5, who do you trust more to protect your academic and personal data?		1	0	0	0	0	0	0	1
	A) 1 (I trust the University much more)	0	19	3	1	6	1	2	32
	B) 2	0	3	3	3	2	0	7	18
	C) 3 (Neutral)	0	9	8	5	22	0	2	46
	D) 4	0	1	0	0	3	0	0	4
	E) 5 (I trust private tech companies much more)	0	2	0	0	0	1	0	3
Total		1	34	14	9	33	2	11	104

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	166.020[a]	30	<.001
Likelihood Ratio	60.326	30	<.001
N of Valid Cases	104		

a. 35 cells (83.3%) have expected count less than 5. The minimum expected count is .01.

Use of AI for College Assignments and Trust in Global Companies:

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
How much of your weekly college assignments are done with the help of AI? * How much do you trust a global company (like OpenAI or Google) with your private academic data?	104	100.0%	0	0.0%	104	100.0%

How much of your weekly college assignments are done with the help of AI? * How much do you trust a global company (like OpenAI or Google) with your private academic data? Crosstabulation

Count

		How much do you trust a global company (like OpenAI or Google) with your private academic data?				
			A)Full trust	B) Partial trust	C) No trust at all	Total
How much of your weekly college assignments are done with the help of AI?		0	0	0	1	1
	A) Almost all (75-100%)	0	8	30	4	42
	B) More than half (50%)	1	12	27	2	42
	C) Very little (Less than 25%)	0	4	10	1	15
	D) I don't use AI at all	0	1	3	0	4
Total		1	25	70	8	104

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	15.485[a]	12	.216
Likelihood Ratio	9.321	12	.675
N of Valid Cases	104		

a. 15 cells (75.0%) have expected count less than 5. The minimum expected count is .01.

The data from 100 respondents reveals a significant "Awareness-Knowledge Gap" within the student population. While a strong majority of students (66%) are aware that global AI tools are privately owned by foreign entities, only 35% are familiar with the specific framework of the "Sovereign Classroom". This suggests that while students recognize the external control of their tools, they lack a clear understanding of the institutional alternatives available to them.

The study further highlights a state of "Functional Dependency." Over 74% of students indicated they would feel either "completely lost" or "stressed" if current AI platforms became unavailable, with 40.8% relying on these tools for the majority of their weekly academic workload. This high dependency is coupled with a deep "Trust Deficit"; a staggering 68% of students report having no trust at all in global corporations regarding the safety of their private academic data. Furthermore, the results indicate a clear demand for regional and social equity. Approximately 50.5% of respondents believe that a locally managed AI system would bridge the socio-economic gap by providing equal access to high-quality tools for all students, regardless of their ability to pay for "Pro" subscriptions. Additionally, 58.3% of the participants expressed a direct preference for a "Sovereign AI" that is safer and specifically trained on their local syllabus, proving that students value relevance and security over the generic outputs of global platforms.

Conclusion

This research concludes that the current model of higher education's reliance on external AI is fundamentally unstable. The data confirms that students are caught in a cycle of high dependency and low trust they use global tools out of necessity while fearing the harvesting of their intellectual property. The "Sovereign Classroom" is not just a theoretical concept; it is a strategic requirement to prevent "Digital Colonialism" and ensure that academic institutions remain the primary guardians of student data.

Infrastructure Shift: Universities must move from being "Passive Consumers" to "Active Creators" by hosting private AI environments. This aligns with the 56.3% of students who believe digital self-reliance is critical for national security. Curricular Integration: Digital Sovereignty should be integrated into the academic experience. Since 46.6% of students support making this a mandatory subject, institutions should implement seminars to educate students on data ownership. Contextual Training: AI tools must be "fine-tuned" on local syllabus and regional nuances to address the 37.9% of students who find current AI outputs too generic.

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Indian English as a Global Linguistic Variety: A Socio Linguistic Study of Usage, Identity and Cultural Negotiations

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Abstract

In the contemporary global context, English has developed into multiple localized varieties, among which Indian English holds a significant position. Shaped by India's linguistic diversity and cultural complexity, Indian English reflects unique patterns of usage and meaning making. This paper examines Indian English as a global linguistic variety by focusing on its role in expressing identity and facilitating cultural negotiation while maintaining international intelligibility. The study adopts a qualitative sociolinguistic approach using examples from literary texts, media discourse, and everyday communication practices. It also analyses codeswitching and hybrid language use to understand how social and cultural factors influence linguistic patterns. The paper argues that Indian English is not merely a derivative of British English but a legitimate and evolving variety with its own linguistic, cultural, and social identity. Furthermore, the study explores how Indian English functions as a bridge between local traditions and global communication, especially in multilingual and multicultural settings. The findings reveal that Indian English embodies both resistance and adaptation within postcolonial and globalized contexts, thereby illustrating the dynamic relationship between language, culture, identity, and power in modern society.

Keywords: Cultural Negotiation, Global English, Indian English, Language Identity, Postcolonial Language, Sociolinguistics

Introduction

Language plays a central role in shaping culture, identity, and social interaction. Among global languages, English occupies a unique position due to its widespread presence across continents and societies. However, it is no longer limited to a single standard form associated with native-speaking countries like Britain or America. Because of colonization, globalization, migration, education, media, and technology, English has evolved into multiple localized forms known as "World Englishes". These varieties reflect the cultural and linguistic realities of different regions while maintaining mutual intelligibility.

Indian English is one of the most influential and widely spoken varieties today. Introduced during British colonial rule, it evolved from an administrative language into one used in education, governance, literature, business, and global communication. India's multilingual environment encourages interaction between English and regional

languages such as Tamil, Hindi, Bengali, Telugu, Malayalam, and Kannada. This interaction produces hybrid forms that reflect India's sociolinguistic richness.

Review of Related Literature

Historical Development of Indian English

English The history of Indian English is closely connected with British colonialism. English entered India during the seventeenth century through trade and colonial administration established by the East India Company. Initially, English was used mainly for commercial and administrative purposes.

However, during the nineteenth century, British educational policies promoted English as a medium of instruction. Thomas Babington Macaulay's "Minute on Indian Education" in 1835 played an important role in institutionalizing English education in India. Macaulay argued that English education would create a class of Indians who were "Indian in blood and colour, but English in taste." As a result, English became associated with higher education, administration, and social prestige.

Despite its colonial origins, Indians gradually appropriated English for their own purposes. Educated Indians used English to participate in political debates, social reforms, and nationalist movements. Leaders such as Mahatma Gandhi, Jawaharlal Nehru, and B. R. Ambedkar employed English to communicate with diverse linguistic communities and to address international audiences. After independence in 1947, debates emerged regarding the status of English in India. While some groups viewed English as a colonial remnant, others considered it essential for national unity and modernization. Ultimately, English continued as an associate official language alongside Hindi. Over time, it became deeply integrated into Indian society. The post-independence period witnessed the expansion of English in education, science, technology, business, and media. The rise of globalization and information technology during the late twentieth century further strengthened the importance of English in India. Today, Indian English functions as both a national link language and an international medium of communication

Concept of "World Englishes"

The idea of "World Englishes" recognizes that English has developed into multiple varieties across different cultural and geographical contexts. Linguist Braj B. Kachru introduced the influential model of three concentric circles of English: Inner Circle – countries where English is the native language, such as Britain and America. Outer Circle – countries where English developed through colonization and functions as a second language, such as India, Nigeria, and Singapore. Expanding Circle – countries where English is used mainly as a foreign language. India belongs to the Outer Circle, where English has acquired institutional and social functions. In such societies, English is adapted according to local cultural and linguistic realities. Therefore, Indian English should not be judged solely according to British or American standards.

The theory of "World Englishes" challenges the idea that native-speaker varieties alone are correct or prestigious. Instead, it emphasizes linguistic diversity and recognizes localized forms of English as legitimate varieties. Indian English thus represents an important example of linguistic adaptation and cultural ownership. Linguistic Features of Indian English Indian English possesses distinctive phonological, lexical, syntactic, and pragmatic features influenced by Indian languages and cultural practices. Phonological

Features Pronunciation in Indian English often reflects the influence of regional languages.

Some common features include: Retroflex pronunciation of consonants such as /t/ and /d/. Reduced distinction between /v/ and /w/. Syllable-timed rhythm instead of stress-timed rhythm. Pronunciation of silent letters in words such as “debt” or “often.” Indian English pronunciation varies across regions because speakers bring features from their mother tongues into English speech. Lexical Features Indian English includes many words and expressions derived from Indian languages and cultural contexts. Examples include:

Prepone – to move an event earlier.
Eve-teasing – harassment of women in public spaces. Cousin brother / cousin sister.
Timepass – something done for entertainment.
Batchmate – classmate from the same batch.
Indian English also incorporates words from Indian languages such as “chai,” “pukka,” “crore,” “guru,” “dhaba,” and “namaste.” These lexical innovations demonstrate the localization of English according to Indian cultural needs.

Objectives

- To examine the historical development of Indian English
- To identify its linguistic characteristics
- To analyse it from a sociolinguistic perspective
- To study the relationship between language and identity
- To understand code-switching and hybrid language practices
- To explore its role in literature, media, and education
- To evaluate its status as a global linguistic variety

Methodology

This study uses a qualitative sociolinguistic approach based on secondary sources such as books, journal articles, literature, newspapers, films, advertisements, and digital media. Postcolonial theory is applied to understand identity, hybridity, and cultural negotiation. Linguistic examples are interpreted within India’s multilingual context.

Syntactic Features

Indian English sometimes differs from British English in sentence structure and grammar. Examples include: “I am having two brothers.” “She is knowing the answer.” Use of tag questions such as “isn’t it?” in varied contexts. Such structures often reflect the influence of Indian language patterns. Though sometimes criticized as deviations, they represent systematic features within Indian English usage. Pragmatic and Discourse Features Indian English communication reflects cultural norms related to politeness, hierarchy, and social relationships. Speakers may use indirect expressions, honorifics, or culturally specific conversational styles.

Analysis

For example: “Kindly do the needful.” “Please revert back.” “What is your good name?” These expressions reveal how English adapts to Indian communicative practices. Indian English and Sociolinguistics studies the relationship between language and society. Indian English provides an important field for sociolinguistic analysis because it exists

within a multilingual and multicultural environment. Language variation in India depends on factors such as region, class, caste, education, gender, and occupation. Urban educated speakers may use English differently from rural speakers. Similarly, English usage varies between formal and informal contexts. English in India also functions as a marker of social mobility and prestige. Fluency in English is often associated with education, employment opportunities, and economic advancement. Consequently, English occupies a powerful social position. At the same time, Indian English reflects democratic linguistic adaptation. Speakers reshape English according to local needs rather than strictly following native norms. This process demonstrates the dynamic interaction between global and local cultures. Sociolinguistic studies also show that Indian English is characterized by code-mixing and multilingual communication. Indian speakers frequently combine English with regional languages in everyday conversations. Such hybrid practices are common in urban spaces, media discourse, and digital communication. For example:

"Let's go for shopping after pooja." "Today meeting is cancelled because of bandh." These expressions illustrate how Indian English integrates local cultural realities into global language structures. Language and Identity in Indian English Language is closely connected with identity formation. Indian English serves as a medium through which individuals express regional, national, social, and global identities. For many educated Indians, English represents modernity, professionalism, and global connectivity. At the same time, Indian English allows speakers to maintain cultural distinctiveness by incorporating indigenous expressions and cultural references. Postcolonial scholars argue that the adaptation of English in former colonies reflects resistance against linguistic domination. Rather than passively imitating British English, Indian speakers transformed English into a language capable of expressing Indian experiences and identities. Indian English literature plays an important role in identity formation. Writers such as R. K. Narayan, Salman Rushdie, Arundhati Roy, and Amitav Ghosh use Indian English creatively to portray Indian society, culture, and history. Salman Rushdie famously argued that Indians have "chutnified" English by mixing it with Indian linguistic and cultural elements. This metaphor captures the hybrid nature of Indian English as a language shaped by diversity and creativity.

Indian English also reflects regional identities. Tamil English, Bengali English, Punjabi English, and other regional variations demonstrate how local linguistic backgrounds influence English usage. Thus, Indian English becomes a site of cultural negotiation where speakers balance local identity with global participation. Code-Switching and Hybrid Language Practices Code-switching refers to the alternation between two or more languages within conversation. In India, code-switching between English and regional languages is extremely common. Examples include: "Naan later call pannuren." "Kal meeting attend panna mudiyuma?" "Yeh assignment tomorrow submit karna hai." Such hybrid communication reflects multilingual competence rather than linguistic deficiency. Code-switching serves several sociolinguistic functions: Expressing cultural identity. Creating social intimacy. Conveying humor or emotion. Demonstrating educational status. Filling lexical gaps. In urban India, hybrid languages such as "Hinglish," "Tanglish," and "Manglish" are increasingly popular. Media industries frequently use mixed language forms in advertisements, films, songs, and social media content. For instance, Bollywood dialogues often combine Hindi and English to appeal to urban youth audiences. Advertisements use hybrid slogans to create relatability and modern appeal. Digital communication platforms such as WhatsApp, Instagram, and YouTube further encourage hybrid language practices. Young speakers freely mix languages while texting

or creating online content. These developments indicate that linguistic boundaries in India are fluid and dynamic. Indian English exists not as a pure or isolated form but as part of a multilingual communicative ecosystem. Indian English in Literature Indian English literature represents one of the most significant contributions of Indian English to global culture. Indian writers have used English to narrate Indian experiences while reshaping the language creatively. Early Indian English writers such as Mulk Raj Anand, Raja Rao, and R. K. Narayan established the foundations of Indian English fiction. Their works portrayed Indian society, traditions, caste systems, poverty, and colonial realities. Raja Rao argued that English in India must adapt itself to Indian sensibilities. He stated that Indians cannot write like the English because their cultural experiences differ. Consequently, Indian writers transformed English syntax, rhythm, and imagery to suit Indian contexts. Postcolonial Indian literature further expanded the possibilities of Indian English. Salman Rushdie's Midnight's Children employs hybrid language, multilingual expressions, and oral storytelling techniques. Arundhati Roy's The God of Small Things creatively manipulates English grammar and vocabulary to reflect regional speech patterns and childhood perspectives. Indian English literature challenges linguistic purity by celebrating hybridity and multilingualism. Writers intentionally incorporate Indian words, myths, food items, rituals, and cultural references without translation. This practice asserts cultural confidence and resists colonial linguistic standards.

Today, Indian English literature enjoys international recognition and contributes significantly to global literary discourse. Indian English has become an artistic medium capable of expressing complex emotional, historical, and cultural realities.

Indian English in Media and Popular Culture

Mass media has played a major role in popularizing Indian English. Television channels, newspapers, radio programs, advertisements, films, and digital platforms widely use Indian English expressions. News media in India often employs localized English vocabulary and discourse patterns. Headlines may combine English with Indian cultural references to attract readers. Advertising language particularly reflects the creativity of Indian English. Advertisers frequently use hybrid slogans combining English and regional languages. Such language creates familiarity and emotional connection with audiences. Cinema also contributes significantly to the spread of Indian English. Bollywood films regularly use English dialogues alongside Hindi and regional languages. Urban characters often speak mixed languages to reflect contemporary social realities

The growth of social media has further transformed Indian English. Internet communication encourages informal writing styles, abbreviations, emojis, and multilingual mixing. Young Indians create innovative expressions through memes, online videos, and digital conversations. Examples include: "Scene kya hai?" "Full busy today." "Timepass vibes." These expressions demonstrate the evolving nature of Indian English in contemporary culture.

Indian English and Education

English occupies a central place in the Indian educational system. It serves as a medium of instruction in schools, colleges, universities, and professional institutions. English proficiency is often viewed as essential for career advancement and global opportunities. The demand for English-medium education has increased rapidly in both urban and rural areas. Parents often associate English education with social mobility and economic success. However, English education in India also creates inequalities. Students from

privileged backgrounds usually have greater access to quality English education compared to marginalized communities. As a result, English sometimes functions as a marker of class distinction. At the same time, Indian English enables communication across linguistic regions. In higher education, English acts as a common medium for scientific, technical, and academic discourse. Teachers and students frequently adapt English according to local classroom contexts. Therefore, Indian English educational practices reflect both global standards and local realities. Recent educational policies emphasize multilingualism while retaining the importance of English. This balance demonstrates India's attempt to preserve linguistic diversity while participating in global communication networks.

Indian English in Globalization

Globalization has increased the international importance of Indian English. India's participation in information technology, business outsourcing, education, healthcare, and international migration has expanded the global visibility of Indian English speakers. Indian professionals working in multinational companies often use English as a primary communication tool. Call centres, software industries, and digital platforms have contributed to the international circulation of Indian English accents and expressions. Indian diasporic communities also spread Indian English across the world. Migrants carry linguistic and cultural practices to countries such as the United States, Canada, Britain, Australia, and the Gulf nations. The global entertainment industry further popularizes Indian English. Indian films, web series, music, and online influencers reach international audiences through digital streaming platforms. Globalization therefore creates both opportunities and challenges for Indian English. On one hand, Indian English gains international recognition. On the other hand, pressures toward linguistic standardization may marginalize local variations. Nevertheless, Indian English continues to evolve as a flexible and adaptive variety capable of functioning in both local and global contexts. Postcolonial Perspectives on Indian English Postcolonial theory provides important insights into the development of Indian English. Colonialism imposed English as a language of power and administration. However, postcolonial societies transformed English into a medium of resistance, creativity, and self-expression. Writers and theorists argue that language can be appropriated and redefined by colonized peoples. Indian English exemplifies this process of linguistic transformation.

The use of Indian cultural references, local idioms, and hybrid expressions challenges the authority of standard British English. Indian speakers demonstrate that English no longer belongs exclusively to native-speaking countries. Homi K. Bhabha's concept of hybridity is particularly relevant to Indian English. Hybridity refers to the mixing of cultures and identities resulting from colonial encounters. Indian English reflects such hybridity through linguistic blending and cultural negotiation. Ngũgĩ wa Thiong'o criticized the dominance of colonial languages in postcolonial societies. However, Indian writers often adopt a different approach by reshaping English rather than rejecting it entirely. Indian English therefore represents both colonial inheritance and postcolonial transformation. It embodies tension between global power structures and local cultural agency.

Challenges Faced by Indian English

Despite its growth and acceptance, Indian English faces several challenges.

Linguistic Prejudice
Many people still consider British or American English superior to Indian English. Indian accents and localized expressions are sometimes mocked or viewed as incorrect. Such attitudes reflect linguistic discrimination rooted in colonial history and native-speaker ideology.

Educational Inequality
Access to English education remains unequal in India. Students from rural and economically disadvantaged backgrounds may face difficulties in acquiring English proficiency. This inequality affects educational opportunities and social mobility. Standardization Issues Indian English lacks complete standardization because of regional diversity. Pronunciation, vocabulary, and grammar vary widely across states and communities. However, such variation is natural in all living languages.

Cultural Tension
Some critics argue that excessive dependence on English threatens indigenous languages and cultural traditions. Concerns exist regarding language shift and declining use of regional languages among urban youth. Nevertheless, multilingualism remains strong in India, and English often coexists with regional languages rather than replacing them entirely. Indian English as a Legitimate Global Variety The recognition of Indian English as a legitimate global variety has increased significantly in recent decades. Linguists now acknowledge that English belongs to all its users, not only native speakers. Indian English possesses: Distinct linguistic features. Functional stability. Literary richness. Cultural relevance.

International intelligibility
It is used by millions of speakers across diverse domains including education, governance, media, literature, and business. Indian English dictionaries, grammar studies, and linguistic research further establish its legitimacy. Universities worldwide now study Indian English as an important field within World Englishes. The growing visibility of Indian professionals and writers in global contexts also strengthens the status of Indian English. Rather than being considered “incorrect English,” Indian English is increasingly recognized as a creative and meaningful variety shaped by historical and cultural realities.

Findings and Discussion
The study reveals several important findings: Indian English has evolved into a distinct and legitimate linguistic variety influenced by India’s multilingual and multicultural environment. Indian English reflects strong connections between language, identity, and cultural expression.

Code-switching and hybrid communication are central features of Indian English usage. Indian English functions effectively in literature, media, education, and global communication. Postcolonial adaptation transformed English from a colonial language into a medium of Indian self-expression. Despite linguistic prejudice and educational inequality, Indian English continues to gain global recognition and acceptance. Indian English demonstrates that language evolves through social interaction, cultural negotiation, and historical transformation.

Conclusion

Indian English has emerged as one of the most significant varieties within the global family of English languages. Shaped by colonial history, multilingual interaction, cultural diversity, and globalization, it reflects the dynamic relationship between language and society in contemporary India. This study demonstrates that Indian English is far more than a borrowed version of British English. It possesses unique phonological, lexical, syntactic, and pragmatic features that express Indian cultural realities and communicative needs. Through processes such as code-switching, hybridization, and linguistic adaptation, Indian speakers have transformed English into a language capable of representing local identities while participating in global discourse. Indian English also plays a crucial role in literature, media, education, and international communication. It functions simultaneously as a marker of identity, a tool of social mobility, and a bridge between regional diversity and global connectivity. In postcolonial contexts, Indian English symbolizes both resistance and adaptation, demonstrating how formerly colonized societies can appropriate and redefine linguistic power. Although challenges such as linguistic prejudice, educational inequality, and concerns about cultural preservation continue to exist, Indian English remains a vibrant and evolving linguistic variety. Its growing acceptance within academic, literary, and global communication networks confirms its legitimacy and significance. Ultimately, the study of Indian English highlights the broader reality that language is not static or owned by any single community. Languages continuously evolve through contact, negotiation, and creativity. Indian English stands as a powerful example of how global languages can be localized, reshaped, and enriched by diverse cultural experiences.

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Blurring the Boundaries Between Pedagogy and Andragogy: Implications for Contemporary Teaching Practices

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Abstract

In the state of Tamil Nadu, the educational institutions and faculty members are adapting new methods for educating students in both the school and college levels which has slowly blurred the boundaries between pedagogy and andragogy. This research aims to find out the causes and consequences of this phenomenon. There are two distinct methodologies used in this study. Conceptual methodology has been used to bring out the basic concepts of andragogy and pedagogy that shape the present education system in Tamil Nadu. It also tries to draw the fine lines between the two distinct methodologies. Survey method is used to find out how the technology and AI has blended pedagogy and andragogy. Based on the opinions collected from the students it also brings out the variation of educational methods in different institutes and boards of study. As a result of findings, it was interpreted that there is an undeniable surge in the usage of AI and E-resources amidst the college students, showing their attempts to indulge in self-learning methods. The differences between the practices of conventional learning methods and pedagogical methods are also brought to the light. As a conclusion, the positive elements of this situation are highlighted while ideas to eliminate the negative aspects are given, after deriving from the opinions of the students through the survey.

Keywords: Andragogy, Conventional, Education, Methodologies, Pedagogy, Teaching

Introduction

While education has been a basic thing since the ancient days, the recent centuries have shown an immense development in the various aspects. There have been new theories and policies being formulated to ensure a fruitful learning. Amidst varied methodologies for education, each method has worked for some, while it went futile for some. This is where a comparative study rises between the methods like pedagogy and andragogy. “Pedagogy is the art and science of teaching children” (Knowles, 1973). According to Hiemstra and Sisco (1990, as cited in Kapur, 2015), under the pedagogical model, the teacher has full responsibility for making decisions about what will be learned, how it will be learned, when it will be learned, and for how long it has to be learnt. The teacher also determines which medium should be used in transmission of learning. According to Knowles (1973), “Andragogy is the art and science of helping adults to learn”. Andragogy is based on the premise where the teacher manages the learning process and facilitates the acquisition of content by the learners (Hiemstra and Sisco, 1990, as cited in Kapur, 2015). This study explores how students have been able to adapt to the varying methods in education. In present, neither the pedagogical methods are restricted to children nor the andragogical

methods are restricted to the adults. In the era of technology and artificial intelligence sticking to one approach for teaching children will not be sufficient to prepare them for a world where they will have to survive AI. The future generation needs to be knowledgeable enough to train AI. This is one of the major reasons for the educational institutions to prefer conceptual and contextual learning from the tender age over rote learning and lecture-based learning. The study also attempts at listing out the students' opinion about various methods of pedagogy and the amount of efficiency it has in the minds of student.

The use of internet among the students have been there ever since the introduction of the technology, but it spread rapidly due to the external factor of Covid-19. It was the time when the need for the online facilities and ample gadgets raised amidst the students for ensuring the smooth functioning of their classes. With access to the web-based learning, students found a way to seek knowledge from various sources including distance learning and e-learning methods.

Following that, the widespread usage of AI tools for the purpose of education, made it easy for the students to understand their subjects and also it helped them with their projects and assignments, making the learning an interactive and interesting process. All these developments and growth have thrown light on the letting go of conventional teaching methods to focus more on the other ways of engaging students.

Review of Related Literature

Conventional Teaching

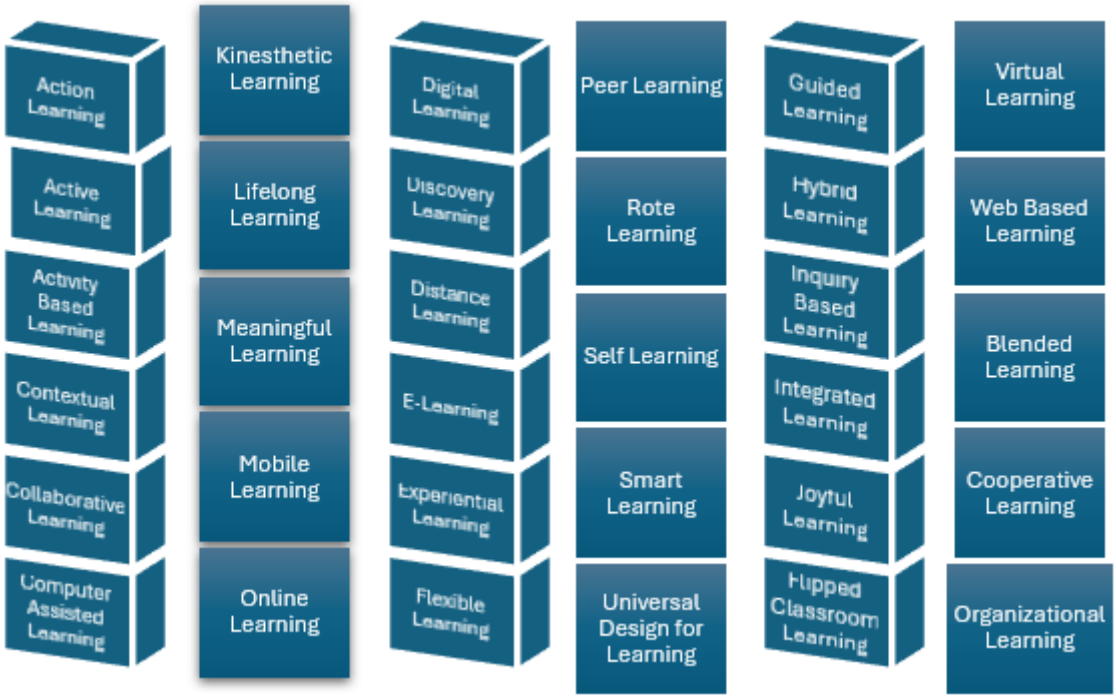
Conventional teaching is a teacher centred method, where the students merely follow the instructions of the teacher. Paulo Freire (1970 / 2005) has called this as a banking concept of education, for the students become simple receivers, where the knowledge is deposited in them. Students are termed depositories, while the teachers are termed as depositors. The knowledge is not shared with the students in the modern methodologies like in the present generation but are just delivered. The students are made to study by repetition and memorization. They do not undergo the full process of learning but just have scope to study the subjects and improve their knowledge. This method has been widely brought under analysis and critical views for being done through instructions, which in-turn passes on the information to students as a passive form learning rather than engaging them in active learning environment. Conventional teaching is termed as traditional education by John Dewey (1938). He has shown the lows of traditional teaching by comparing it with progressive education. This method is seen to lack experiential learning as it focusses only on the delivery of subjects as contents.

Pedagogy - Meaning

According to Christina Lanning (2022) Pedagogy is the study of teaching methods, including the aims of education and the ways in which such goals may be achieved. The field relies heavily on educational psychology, which encompasses scientific theories of learning, and to some extent on the philosophy of education, which considers the aims and value of education from a philosophical perspective. Pedagogy is a method that isn't merely restricted to just children if used in the right sense. It is basically an approach of teaching, which enhances academic achievement, social and emotional development, acquisition of technical skills, and a general ability to contribute to society. Pedagogy involves the whole process of not just teaching but educating students.

Pedagogy - Methods

As already said, pedagogy is not just a single approach towards teaching kids, but it has multiple facets. According to Yudhisthir Mishra and Laxmi Priya Mishra (2021), 33 pedagogical learning methods are discussed in Contemporary Pedagogy – I.



The common methods that are often practiced in the current generation educational institutions include contextual learning, collaborative learning, online learning, distance learning, peer learning, rote learning, self-learning and guided learning. A brief introduction for all the above cited methods is as follows;

Contextual Learning

Contextual learning connects academic content to real-life situations, helping learners understand concepts by relating them to practical experiences. It enhances relevance and application of knowledge.

Example: Learning mathematics through budgeting or shopping scenarios where students apply calculations to everyday financial decisions.

Collaborative Learning

Collaborative learning involves students working together in groups to achieve shared learning goals. It promotes interaction, communication, and collective problem-solving.

Example: A group project where students jointly research a topic, divide tasks, discuss ideas, and present findings together.

Online Learning

Online learning uses digital platforms and the internet to deliver educational content, allowing flexibility in time and location. It often includes videos, quizzes, and virtual discussions.

Example: Attending classes through platforms like Google Classroom or watching recorded lectures and submitting assignments online.

Distance Learning
Distance learning refers to education where teachers and learners are physically separated, and instruction is delivered through various media like online platforms, television, or correspondence.
Example: A student completing a degree remotely without attending physical classes, using study materials and virtual communication.

Peer Learning
Peer learning involves students learning from and with each other by sharing knowledge, explaining concepts, and discussing ideas. It enhances understanding and communication skills.
Example: Two students studying together, where one explains a concept to the other, improving learning for both.

Rote Learning
Rote learning is based on memorization through repetition, often without deep understanding of the concept. It is commonly used for recalling facts, formulas, or definitions.
Example: Memorizing multiplication tables or definitions for an exam without understanding their practical application.

Self-Learning
Self-learning is a process where individuals take initiative to learn independently, without direct supervision. It involves setting goals, finding resources, and evaluating one's own progress.
Example: Learning a new skill like coding through online tutorials and practice without a formal teacher.

Guided Learning
Guided learning involves teacher support and direction while allowing students some level of independence. The teacher facilitates learning by providing instructions, feedback, and resources.
Example: A teacher giving step-by-step guidance during a lab experiment while students perform the activity themselves.

Andragogy - Meaning
Lindeman (1930) has brought out the differentiation between the conventional education against the andragogical methods of education. Knowles (1973) similarly argued about how andragogy is a branch of education, that differs from the highly practiced method back then; the conventional / traditional education. While there is a common misconception that andragogy is a development that's against the principles of pedagogy, that's not the case. This is because, both the pedagogy and andragogy have scope for the learners to discover and find, while it is often missing in conventional educational methods.

Andragogy - Principles
Based on the words of Malcolm Knowles, there are five principles that defines the purpose of andragogy.

- The learner is self-directed.
- The learner is willing and ready to learn
- The learner brings in the knowledge and experience

- The learner's learning is oriented to the relevancy of their field
- The learner is self-motivated

Andragogy - Common Methods

Project-Based Learning

Project-based learning is an instructional approach where students gain knowledge and skills by working over an extended period to investigate and respond to complex questions or problems. It emphasizes active exploration, collaboration, and real-world application. Learners take responsibility for planning and executing tasks, often producing a final product or presentation.
Example: Students designing a sustainable house model, integrating concepts from science, mathematics, and environmental studies.

Challenge-Based Learning (CBL)

Challenge-based learning is a student-centred approach where learners work on real-world challenges, identify problems, research solutions, and implement actionable outcomes. It encourages critical thinking, creativity, and social responsibility. Unlike project-based learning, it focuses more on solving authentic community or global issues.
Example: Students addressing plastic waste in their locality by researching alternatives, creating awareness campaigns, and proposing practical solutions.

Competency-Based Learning (CBL)

Competency-based learning focuses on learners achieving specific skills or competencies at their own pace rather than progressing based on time. Mastery of content is prioritized, and learners advance only after demonstrating understanding and ability. It supports personalized learning and continuous assessment.
Example: A student mastering a programming concept through practice exercises and moving to advanced topics only after demonstrating proficiency.

Impact of Covid-19 in education

Technology and education have gone together for decades now. But on the other hand, the technology and it's advancements in education reached a wider audience of all standards and grades of learners. This shift didn't come easily. There were difficulties in implementing the digital learning during the lockdown times. The book, Teaching and Learning During Covid-19 Pandemic attempts to bring together a lot of opinions and research surveys taken during the time of 2020 lockdown. It was the time when the online classes were introduced among the regular school and college students to keep them engaged with their syllabus. But as of today, the reach of online mode of education wasn't pretty easy due to various aspects. In one such research survey according to Dr. Sambit K Padhi & Subrat Kumar Padhi (as cited in the book), the researchers have discovered that among their survey audience 76% of the students didn't have a prior experience with computers. Not just that, but also there was a comparative difference in the access to the computers between the students at urban and rural range. This very reason also made the teachers and students to be reluctant towards the change from regular classes to online mode. But the time and situation required it, upon which it was mandated. According to the words of Professor Dr. Surekha Sundari Swain & Saraswati Nanda (as cited in the book) over 15 websites were created to ensure the smooth functioning of online classes and digital learning for the students. Those websites include; Socrative, Kahoot, Edmodo, Animoto, TED-ed, etc. This not just enabled an engaging learning method for students, but also an easier teaching method for the teachers adding on to their effective methods of teaching. Apart from this, one of the highly used modes of education during lockdown was the YouTube classes. Students were regulated to

watch the lesson-based videos by their teachers in YouTube as a live stream or as a recorded version. Even in such a case, there were difficulties faced by the students in following it up. In the survey undertaken by Dr. Debendra Kumar Sethi, Prasanta Kumar Panigrahi & Sumitra Parida (as cited in the book), the results clearly conveyed that only 32% of school students and 34% of elementary school students were actively participating in the YouTube classes conducted by the students. The remaining students were either not interested or lacked the required facilities to continue their online mode of education. In more ways like this, the online mode of education slowly created an everlasting impact in the students' life and started to overrule, nevertheless. Most of the students started to own their personal gadgets or access to internet only for their online classes, which eventually led the internet take over the students' ways of education by a whirlwind.

Impact of AI in education

Artificial Intelligence (AI) has brought major changes to the field of education by making learning more flexible, interactive, and accessible. AI tools help teachers prepare lessons, generate study materials, evaluate assignments, and provide feedback more efficiently, reducing their workload and improving classroom management (Bhawna Solanki, 2025). At the same time, students benefit from personalized learning experiences, as AI systems can adapt content according to individual learning speed and understanding. This has encouraged self-learning and independent study habits, which are closely connected to modern learner-cantered approaches (Bhawna Solanki, 2025) AI has also played an important role in the growth of online and distance learning, especially during and after the COVID-19 pandemic. Digital platforms supported continuous learning even when traditional classrooms were closed, allowing students and teachers to stay connected from different locations (Purushottam Lal, 2020). In addition, AI-based educational applications have improved access to learning resources and made education more convenient for many learners.

However, researchers also point out certain limitations of AI in education. Although AI can support teaching and learning processes, it cannot fully replace human teachers, emotional understanding, creativity, and interpersonal interaction in classrooms (Purushottam Lal, 2020). Excessive dependence on AI may also reduce students' critical thinking and originality. Therefore, many scholars suggest using AI as a supportive educational tool rather than a complete substitute for traditional teaching. This balance between technology and conventional instruction reflects the gradual blending of pedagogical and andragogical learning approaches in modern education.

Problem Statement

The current generation requires the teachers to move from the usual lecture-based and teacher centred learning methods. This is where the distinction between pedagogy and andragogy are blurred and the implications are uncertain.

Objectives

- To highlight the basic concepts of pedagogical and andragogical methods
- To emphasize student's perspective on the blurring differences
- To understand how different boards of education approach teaching methods
- To understand the implications of AI in education
- To evaluate the need of technology during the transition from higher secondary to higher education

- To assess the role of Covid-19 in educational conditions in India

Methodology

The required data for this research is brought through both the primary and secondary sources. This study adopted quantitative approach by using two different questionnaires to derive the response from the target respondents and references from books and journal were used for drawing a basic outline for the theme of the paper.

Primary Data

Around 50 questions were asked to the people from the age of 18 to 30 years. These questions focused on the ways of their school and college education and how various external factors like AI, technological development and different methods of teaching and learning shaped their entire process of learning. The survey revealed a common pattern of studying among the students. Furthermore, an attempt to analyse the difference in the teaching among the different board of studies was done.

Secondary Data

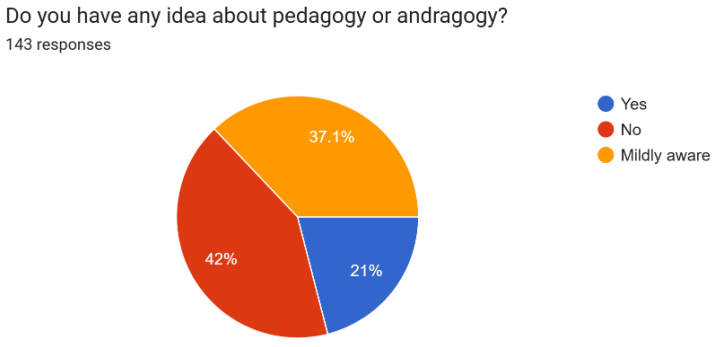
The literature review section of this research sheds light on the previously published contents on the themes of andragogy, pedagogy, AI in education and other topics relevant to the theme. The results derived through the survey are applied on the basis of the understanding from the secondary data.

Analysis

With the age of respondents being from 18 to 30, there was a varied range of answers. Each set of responses opened way towards more insights on the research topics.

Awareness about Pedagogy and Andragogy

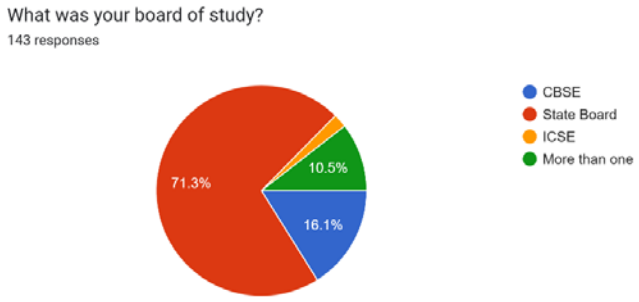
Among 143 responses, 42 percentage of the respondents remain oblivious to the themes of andragogy and pedagogy. This unawareness did not hinder the process of the survey, as it explored the concepts in a simple manner without getting too technical for the audience.



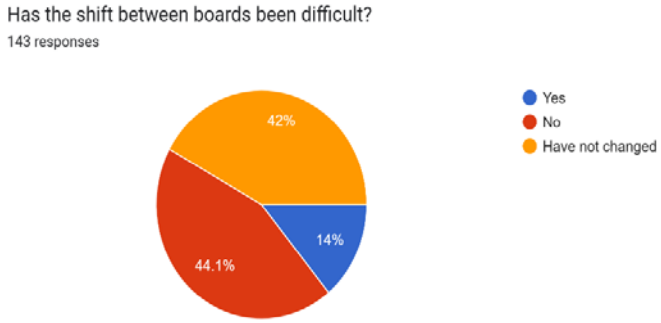
Board Of Education in School Level

One of the major differences in the teaching methods among the faculty comes from the difference in board of studies. To understand this, a set of questionnaires was laid out to students who have studied in more than one board of studies in the secondary and higher secondary levels. In this survey, the respondents are mainly (71%) from the stream of State Board (Tamil Nadu) mode of education. This highlights the fact that the common response

of the respondents is highly based on the perception from the methods followed by State Board of education.

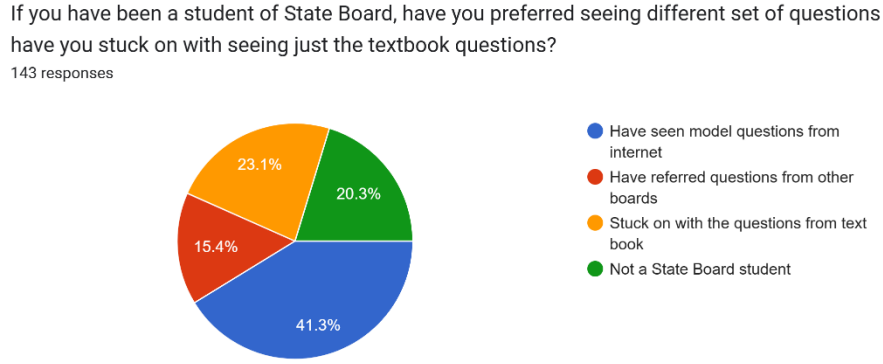


The students who have experienced the shift has mentioned a visible difficulty in the change.



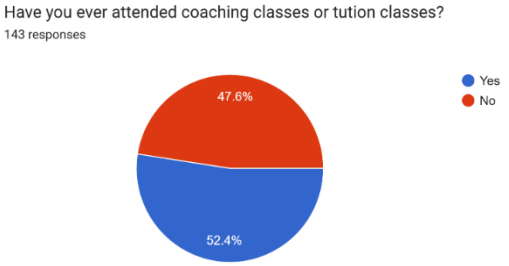
In a separate survey, students who experienced the shift were given an opportunity to voice out the differences in different boards of education. They explained how all the three, CBSE, ICSE, Tamil Nadu State Board had distinct variations from one another. The common observation derived from that is how conventional method of learning is often preferred by the Tamil Nadu State Board educators. This method gives more space to the rote learning, reducing the chance of employing andragogical methods or different methods of pedagogy. Students have stated how the importance towards grades have diminished the process of fun learning. This sheds light on the lack of innovative methods that could be employed to enhance the learning process. This plays a relevant role in this study, for school is a place where students should be given scope to explore different methods of pedagogy, following which they can explore self-learning (andragogical) methods in higher education. Students from CBSE and ICSE have been able to benefit from the depth and range of the concepts owing to the methods of their learning. These boards have depended more on self-learning and engaging methods. In few cases, the difference in the boards also depended on the type of institution. Few institutions which followed multiple boards have practiced similar type of coaching in all of them, with difference being shown only in the cases of higher secondary classes. (G-form attached in the reference)

The question pattern of main exams in Tamil Nadu State Board usually sticks on to the questions from the text books. This limits students' willingness to do an in-depth self-study of the topics. But in the current generation, the students (71% of state board students from the respondents) have shown a visibly strong interest in referring more questions with the help of technology to increase their knowledge. This is a live example of Malcolm Knowles principle of the learners being self-motivated and self-directed.

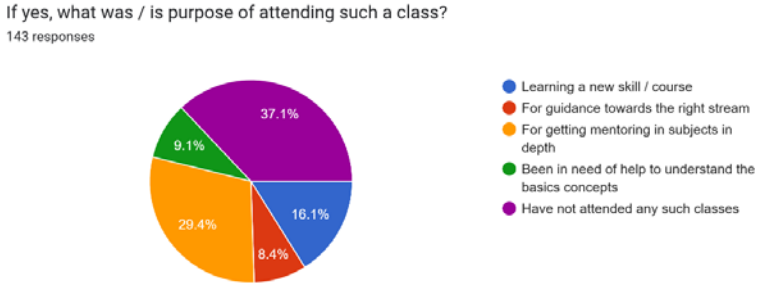


Necessity of Extra Coaching Classes

Around 52% of the respondents are found to have attended additional classes to develop their skill outside the school or college premises. On one side, this shows the increasing interest in the students to learn more beyond their curriculum, on the other side, it also explains how students had to rely on the coaching classes after their lack of understanding from the traditional educational institutions.



The chart below explains how only 23 out of 90 respondents have been to extra classes for learning extra skills. The remaining majority of the persons who have attended the classes have always been inclined towards learning the basics or mastering their curriculum through extra guidance. There could be a whole new thesis on the aid provided by such classes in the development of students.



Findings and Discussion

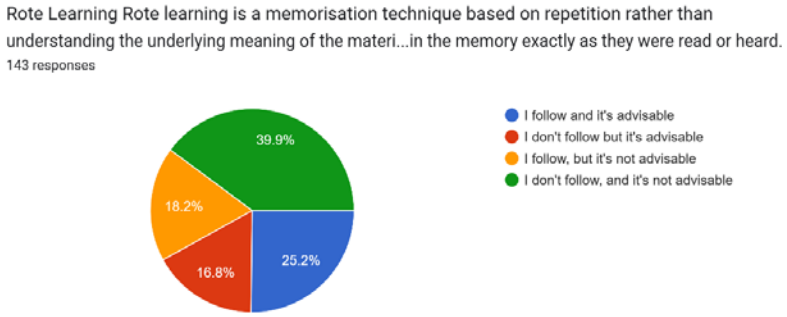
Transition From Secondary Education to Higher Education

The topic of a student changing their learning methods during the transition from being a school student to a college / university student is highly visible on various aspects. In the present generation, that is, the respondents of the survey are the people aged 18 to 30, meaning that their transition from school to college saw a huge leap in the humongous

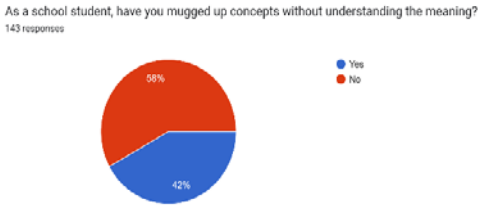
growth of AI and an awareness of various learning methods apart from the traditional classes, thanks to the Covid-19 Lockdown, which enabled online classes and many other forms of classes.

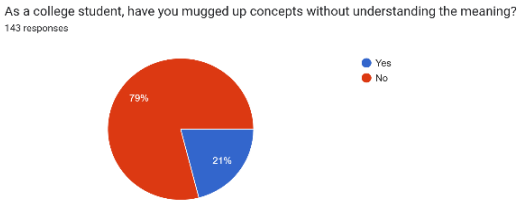
Rote Learning Method

Rote learning method has been a common method practiced in the education system of India for over years now. This refers to the type of banking concept of education, where the students are seated as mere listeners without getting to participate, explore and learn on their own. The evolution from school to college, reduces the students from practicing this method by merely just memorizing.



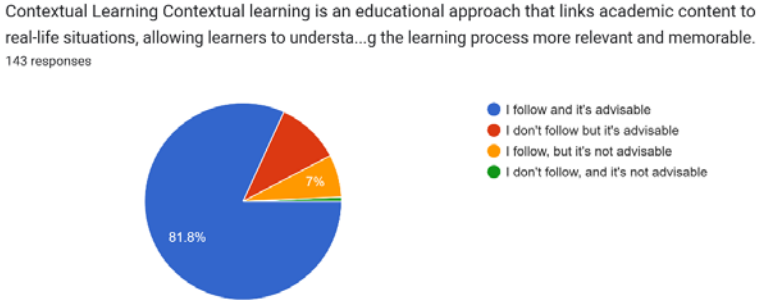
Even though, few people still follow this methodology, most have changed their ways. The percentage of students not following this method have considerably doubled up, when they have reached college.

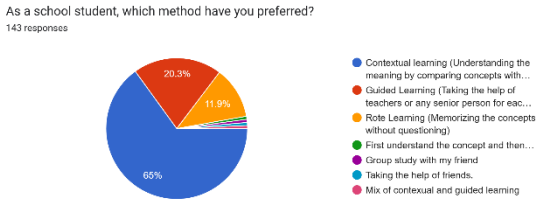


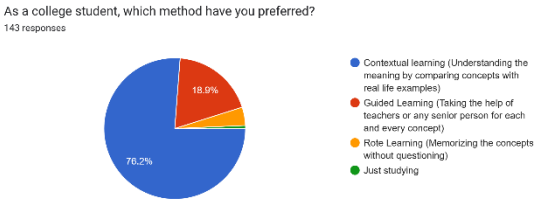


Contextual Learning Method

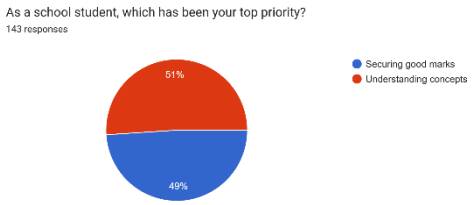
The straight contradiction to the above method is contextual learning method, where the students learn the concepts only through gaining a full clarity and understanding on the topic. In present scenario, this method if being highly fuelled thanks to the help of artificial intelligence and technology.

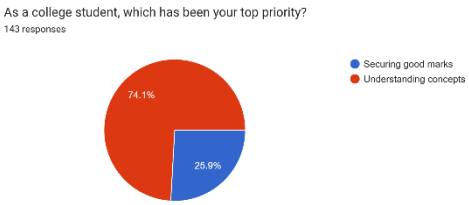






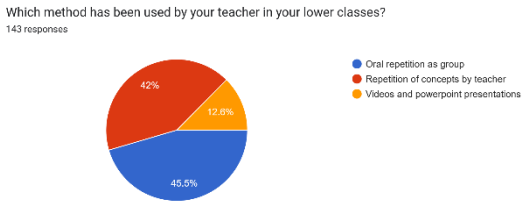
With the growth of people following contextual method, the priorities of learning have visibly shifted from being towards good mark to being towards a deeper understanding of the concepts.

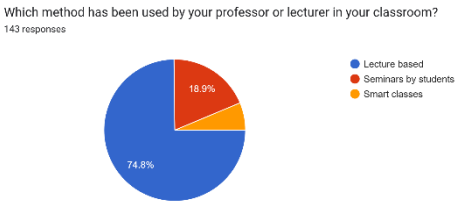




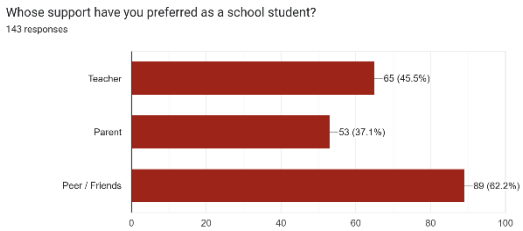
Lack Of Smart Classes

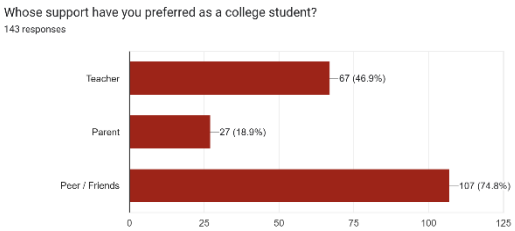
Students turn towards AI for it's detailed illustrations and clear explanations through colourful and vibrant presentation. This is because, in both the school and college level, the percentage of faculty using smart class is very lesser than the one sticking on with the traditional methods of teaching.





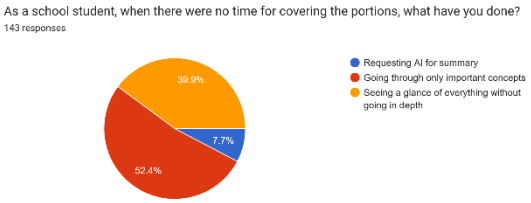
Few more questions were asked in the survey to understand the learning patterns of the students. Questions like students' preference of reading methods (silently or loudly, whose help they prefer, how often they study) were laid out. This attempted to learn how students are adapted to most of the pedagogical methods, without actually realising the benefits and tactics of those methods. Most of the people have seemed to be in favour of seeking their friends' or peers' help before their exam times to ensure they understand the concepts. This raises the importance of peer learning practice.

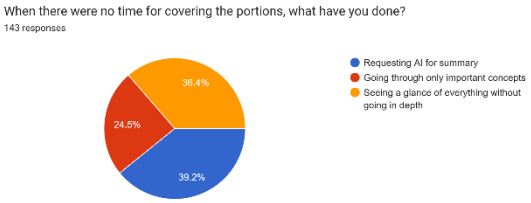




Covering Portions

With the advent use of AI, respondents have given a data which shows them seeking help from various sources at times when they felt difficult to complete the portions during their school days. At the same time, in their college days, they have extensively used AI by requesting the summary of their syllabus. This is observed as one of the most common and basic usage of AI in the current learning methodologies.

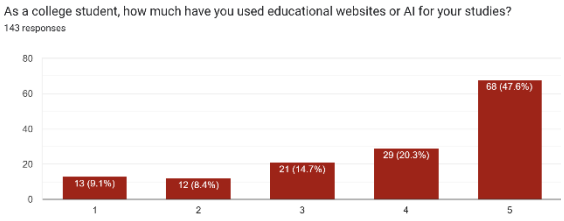


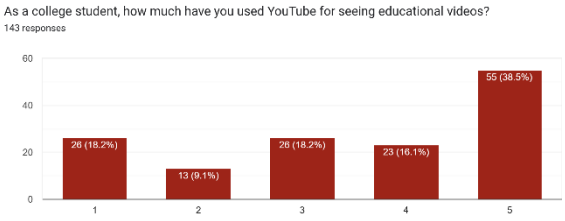


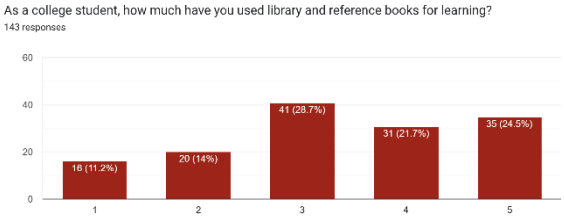
With this, they were also able to go from just going through the important concepts to going through everything in a summarised way.

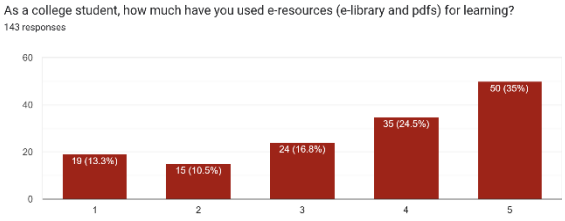
Growing Interest

One of the major observations among the respondents is how they have started using the available resources and technology in order to learn upon their own interest rather than simply depending upon the facilitators.







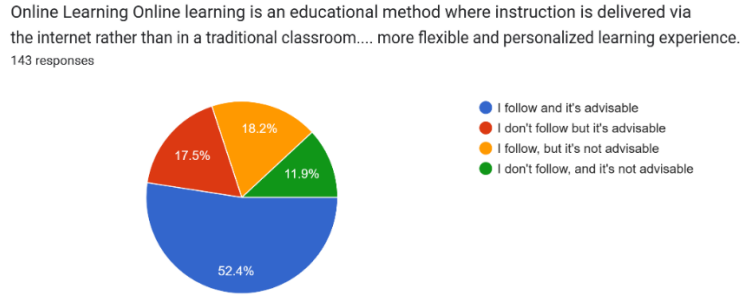


This is almost double the percentage of the students have used these methods during the school days.

Other Common Learning Methods

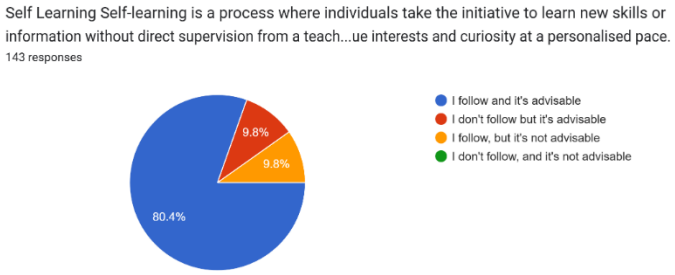
Online Learning

Online learning is one of the most common practices of learning in the present day. Inspite of attending traditional classes, students gain a lot of information and in-depth clarity with the help of various online sources. Online learning doesn't simply restrict itself within the bounds of online classes, but instead it's a broad spectrum under which various aspects like referring E-resources, connecting with distant educators, and more such things are made possible. Around 52% have shown their acceptance in following the method and nearly 70% of the respondents have been affirmative towards its positive reflection.



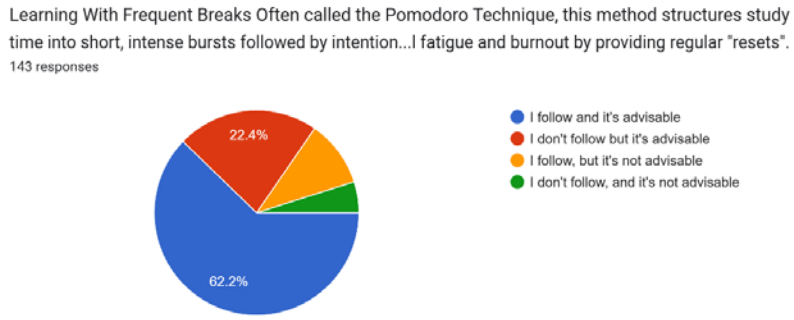
Self-Learning

Self-learning is the simple term defining the basics of andragogy. Over 90% of the respondents have accepted that it is an advisable method to pursue the process of learning. Self-Learning comes across as a method, where one doesn't seek help from anybody in their real life, which may include friends, mentors and family. They indulge in browsing the internet of books by themselves without relying on anybody else. People feel this to be an advisable method mainly because of it's self-paced process. The process can involve breaks or can be rushed depending upon the need of the hour which totally relies on the person who's learning.



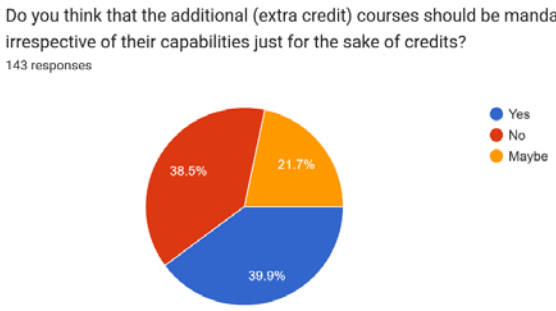
Learning With Frequent Breaks

Learning with frequent breaks may come across as a method that develops the lack of concentration and reduction in span of attention among the learners. There is a significant growth in the learning with the benefits being spread over various aspects that includes increased focus and concentration, improved time management, higher productivity and output, reduced burnout and fatigue, procrastination deterrent and increased motivation and sense of progress (Nadia Lemay, 2025). Similarly, around 73% of the people have understood it's importance and have agreed it to be an advisable method.

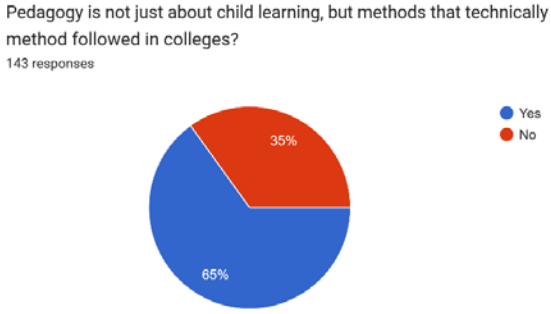


Opinions on the Learning as a Scheme

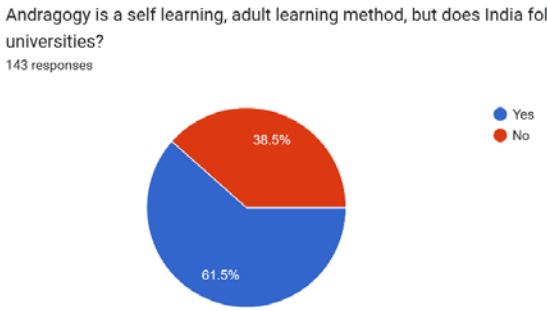
In the evolving education system of the present day, the growth of AI and technology have made the students seek more knowledge, at the same time, there's a considerable downfall in the willingness of students to strive hard towards their learning process. The conventional teaching methods have made students comfortable with being spoon fed. This could be clearly seen through the response given for the question about the need to mandate all the extra and add-on credit courses to the students irrespective of their capabilities just for the sake of enabling them to earn more credits in their degree programme. This raises a serious concern on the lack of students' accountability to enrol themselves for new skills development courses.



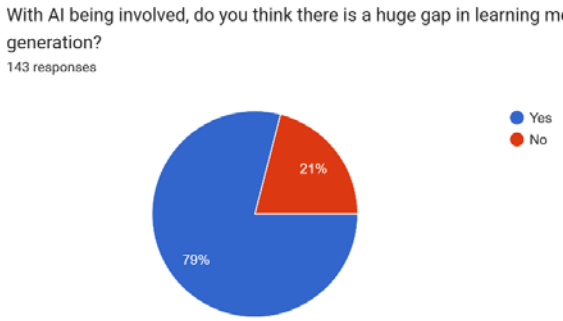
On the other hand, this could be seen as a result of pedagogical methods being followed in the higher education sector rather than letting the students explore themselves to follow the self-learning option with an ample guidance from the mentors.



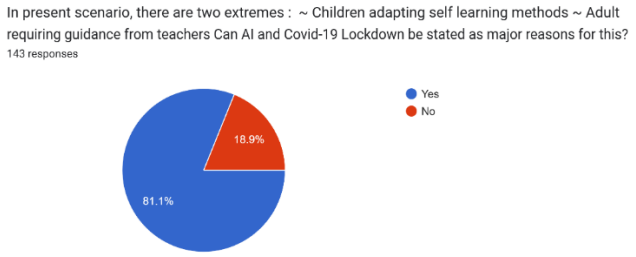
The respondents have also mentioned how the andragogical methods are practiced too, along with the pedagogical teaching methods.



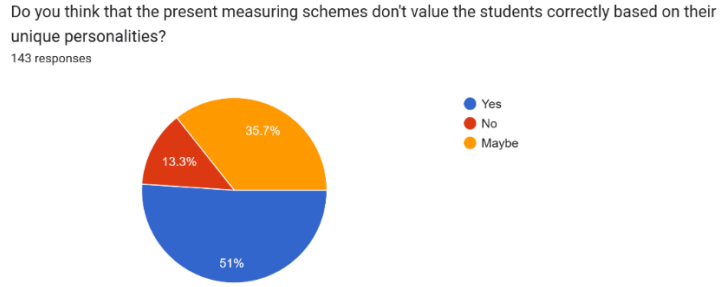
While, the era of AI is being felt and realised in full swing, it has definitely increased the gap in the learning methods between the users and non-users of AI. Usage of AI can be a good time saver, and at the same time, it reduces the interest to put efforts. On the other hand, not all have access to AI, either because of the lack of technological awareness or lack of trust over the artificial intelligence.



On the other hand, two of the major reasons for the gap in the present learning scenario are considered to be the Covid-19 Lockdown and the raising growth of AI. As said, AI can bring the best and worst out of the educational methods. AI opens up the scope for a person to explore more and dwell deeper into the concepts. This helps one learn in solitude, without the need to fully rely on the guide or mentor. But on the other hand, AI helps students finish their assignments without much of their input. This reduces the human creativity involved and also deprives the student a chance to learn something new related to the topic and relevant to the scope of their study. Around 82% of the respondents have accepted these two situations to have escalated the distinct division among the method of the students. This leads to a situation where the primary level learners are able to practice andragogical methods, but analysing their learning objectives, while it creates a situation for the students of higher education to struggle due to their growing dependency on AI.



While students are trying their best to develop themselves with the help of technology and AI, they still feel the lack of proper measuring tools from the educational institutions to assess their knowledge and development.



Conclusion

This paper, mainly deals with the implications of pedagogical and andragogical methods. It not just highlights the involvement of AI in the present day but also tries to highlight the defects that are still going on despite the education system growing to the era of AI and high-end technology. There is a lot of scope for the AI to improve the standards of education in a meaningful way rather than simply being used as an aid for the students to complete their assignments and worksheets. In terms of the topic pedagogy and andragogy amidst AI, it is a clear sign that AI is enabling the self-motivated learning process for everyone and when used rightly by the boards of education, it can be fruitful. At the same time, how much ever AI is easy and handy, one needs a facilitator to guide them at the start, following which they can seek the assistance of AI to dwell deeper into their sectors of interests.

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Are We Educated or Just Qualified

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Abstract

In the modern world, education has become one of the most important foundations for personal growth, economic development, and social progress. However, the meaning of education has gradually changed over time. Today, many individuals and institutions measure success through marks, ranks, degrees, and certificates rather than knowledge, values, creativity, and practical understanding. This has created an important debate in society: are people truly educated, or are they merely qualified? Qualification refers to the possession of academic credentials that prove completion of a course or program, while education is a broader concept that includes intellectual growth, moral development, emotional intelligence, communication skills, critical thinking, social responsibility, and the ability to apply knowledge in real-life situations. In many educational systems, students are trained to memorize information for examinations instead of understanding concepts deeply. As a result, many graduates achieve high academic scores but struggle with problem-solving, decision-making, teamwork, adaptability, and ethical responsibility in professional and social environments. The present study explores the widening gap between education and qualification in contemporary society. It highlights how examination-oriented learning, rote memorization, pressure for grades, unemployment among graduates, and lack of practical exposure have reduced education into a process of certification. The paper also examines the influence of technology, artificial intelligence, social media, and digital learning platforms on modern education. While technological advancement has improved accessibility and learning opportunities, it has also increased dependency on shortcuts, superficial learning, and information overload. The study emphasizes that true education should not only prepare individuals for employment but also shape them into responsible citizens who contribute positively to society. This paper further discusses the role of teachers, parents, educational institutions, and governments in transforming the educational system. Holistic education, skill-based learning, experiential learning, value-based education, creativity, innovation, communication skills, and emotional intelligence are identified as essential components of real education. The research concludes that degrees alone cannot define an educated person. A truly educated individual is one who possesses wisdom, humanity, ethical values, critical thinking, adaptability, and the ability to use knowledge for personal and societal development. Therefore, modern education systems must move beyond qualification-cantered approaches and focus on developing complete human beings capable of facing the challenges of the twenty-first century.

Keywords: Critical Thinking, Education, Moral Values, Qualification, Skills

Introduction

Education is often described as the most powerful tool for transforming individuals and societies. It shapes human behaviour, develops intellectual ability, builds moral values, and prepares individuals for social and professional life. From ancient civilizations to the modern digital era, education has played a central role in human development. However, in recent decades, the concept of education has undergone a major transformation. Instead of focusing on understanding, wisdom, and character development, many educational systems now emphasize marks, examinations, rankings, certificates, and employability. This shift has created a major question in society: are people genuinely educated, or are they simply qualified?

Qualification refers to formal recognition received after completing a course, examination, or academic program. It is usually represented through degrees, diplomas, certificates, and academic scores. Education, on the other hand, is a broader and deeper process that shapes a person intellectually, emotionally, morally, and socially. A qualified person may possess theoretical knowledge and academic credentials, but an educated person demonstrates understanding, ethics, creativity, responsibility, and the ability to apply knowledge meaningfully in life. In the current educational system, success is often measured by academic performance rather than actual learning. Students are trained to memorize textbooks and reproduce answers in examinations. The pressure to secure high marks begins at an early age and continues throughout school and college life. Parents, teachers, and society frequently judge students based on grades and rankings. As a result, students focus more on scoring marks than understanding concepts or developing practical abilities.

Review of Related Literature

The rise of competition in education has also increased the commercialization of learning. Coaching centres, online courses, private institutions, and exam-oriented training programs have transformed education into a business model in many countries. Students spend years preparing for competitive examinations but often lack communication skills, creativity, emotional intelligence, leadership ability, and practical exposure. This creates a situation where graduates possess qualifications but struggle to adapt to real-world challenges.

Another major concern is graduate unemployment. Many employers report that graduates lack employability skills despite holding academic degrees. Industries today require individuals who can think critically, solve problems, communicate effectively, work in teams, and adapt to changing situations. However, many educational institutions continue to focus heavily on theoretical instruction rather than practical learning. This mismatch between education and employment demonstrates the gap between qualification and true education. Technology and artificial intelligence have also influenced modern education significantly. Digital learning platforms, online classes, and AI-based educational tools have made knowledge more accessible than ever before. Students can now learn from global resources, attend virtual classrooms, and gain information instantly through the internet. While these advancements have improved educational accessibility, they have also encouraged superficial learning habits. Many students depend heavily on online summaries, artificial intelligence tools, and ready-made answers instead of engaging in deep understanding and critical thinking.

The issue is not limited to academic performance alone. Modern society increasingly witnesses ethical problems, intolerance, lack of empathy, mental health challenges, corruption, and social irresponsibility among educated populations. This raises an important

concern: if education truly develops humanity and wisdom, why do many highly qualified individuals fail to demonstrate ethical and social responsibility? This question highlights the difference between being academically qualified and genuinely educated.

Historically, education was designed to develop character, wisdom, discipline, and social harmony. Ancient philosophers such as Socrates, Plato, Aristotle, Confucius, and Indian scholars emphasized moral development and self-awareness as essential aspects of learning. Education was considered a process of transforming the mind and soul rather than merely acquiring information. In contrast, modern systems often prioritize measurable outcomes such as grades, placements, and institutional rankings. The twenty-first century demands a new approach to education. In a rapidly changing world influenced by globalization, technological advancement, and artificial intelligence, individuals require more than academic knowledge. They need creativity, emotional intelligence, adaptability, leadership, collaboration, ethical thinking, and lifelong learning abilities. Education should therefore prepare students not only for jobs but also for life.

This paper examines the growing gap between education and qualification in contemporary society. It explores the limitations of examination-oriented systems, the impact of technology on learning, the importance of moral and practical education, and the role of educational institutions in shaping future generations. The study argues that qualifications alone cannot define human intelligence or success. True education involves developing complete individuals who can think independently, act ethically, contribute positively to society, and continuously grow throughout life.

Objectives

The objectives of this study are:

- To understand the difference between education and qualification.
- To analyze the limitations of examination-oriented learning.
- To examine the role of technology and artificial intelligence in modern education.
- To identify the importance of practical skills, moral values, and critical thinking.
- To suggest reforms for creating a more holistic and meaningful educational system.

Methodology

This study is based on qualitative and analytical research methods. The paper uses secondary sources of information collected from books, academic journals, educational reports, articles, government publications, websites, and previous research studies related to education systems, qualification frameworks, employability, and holistic learning.

The study follows a descriptive research design to examine the relationship between education and qualification in modern society. Various educational theories and practical examples were analyzed to understand how examination-oriented systems influence students' learning behaviour and skill development.

Data for the study were collected from:

Research journals related to education and pedagogy.

Articles discussing modern educational challenges.

Reports on employability and graduate skills.

Publications on artificial intelligence and digital learning.

Books related to philosophy of education and value-based learning.

The study also includes comparative analysis between traditional learning methods and modern qualification-oriented education systems. Observations regarding student behaviour, academic competition, skill gaps, and social expectations were analyzed conceptually.

The research primarily focuses on higher education students and modern educational institutions. It examines how academic pressure, technological dependence, and social expectations influence learning outcomes and personal development.

Limitations of the study include dependence on secondary data and conceptual analysis rather than primary survey methods. However, the study provides meaningful insights into the growing gap between education and qualification.

Analysis

Understanding the Difference Between Education and Qualification

The terms “education” and “qualification” are often used interchangeably, but they differ significantly in meaning and purpose. Qualification refers to formal recognition obtained through examinations, degrees, diplomas, and certificates. It indicates that an individual has completed a specific academic program or training process.

Education, however, is much broader. It involves the development of knowledge, wisdom, character, ethics, creativity, emotional intelligence, and social awareness. An educated person understands how to apply knowledge responsibly and effectively in real-life situations.

For example, a student may score high marks in science examinations but fail to apply scientific thinking to solve practical problems. Similarly, a person may possess professional qualifications but lack empathy, honesty, or communication skills. This demonstrates that qualification alone does not guarantee true education.

Modern society often gives greater importance to certificates than actual understanding. Employers ask for degrees, institutions advertise placement records, and students pursue qualifications mainly for career opportunities. As a result, education becomes a race for credentials rather than a process of intellectual and personal growth.

Findings and Discussion

Examination-Oriented Learning

One of the biggest challenges in modern education is examination-oriented learning. Students are trained to memorize information instead of understanding concepts deeply. Schools and colleges often focus on syllabus completion, test preparation, and scoring methods rather than critical thinking and creativity.

This system creates several negative consequences:

Rote Memorization

Students memorize answers for examinations without understanding the meaning behind concepts. After exams, much of the information is forgotten.

Lack of Creativity

Examination systems reward standard answers instead of original thinking. Students fear making mistakes and avoid experimentation.

Academic Pressure

The pressure to achieve high marks causes stress, anxiety, depression, and fear of failure among students.

Reduced Curiosity

Students study mainly to pass examinations rather than to gain knowledge or satisfy curiosity.

Inequality

Students who are skilled in memorization often perform better academically, while creative and practical learners may struggle in traditional examination systems. This educational culture limits intellectual growth and prevents students from developing real-world abilities.

Skill Gap in Modern Graduates

Employers across the world frequently report that graduates lack essential employability skills despite holding academic qualifications. This problem highlights the gap between theoretical education and practical application.

Important skills often missing among graduates include:

Communication skills

Problem-solving ability

Leadership qualities

Teamwork

Emotional intelligence

Adaptability

Time management

Critical thinking

Decision-making ability

Ethical understanding

Many graduates perform well in written examinations but struggle during interviews, workplace interactions, and professional responsibilities. This happens because educational institutions focus more on theoretical learning than experiential learning.

Internships, industry exposure, practical projects, and skill-based training are often limited in traditional academic systems. As a result, students graduate with degrees but without confidence or practical competence.

The Role of Teachers in True Education

Teachers play a crucial role in shaping future generations. A teacher is not merely a provider of information but also a mentor, guide, motivator, and role model.

True education requires teachers to:

Encourage independent thinking.

Inspire curiosity and creativity.

Promote ethical values.

Create interactive learning environments.

Support emotional and mental well-being.

Encourage practical learning experiences.

Develop communication and leadership skills.

Unfortunately, many teachers themselves are pressured by examination systems and institutional expectations. They often focus on completing portions and preparing students for exams instead of nurturing intellectual development. Teacher training programs should therefore emphasize modern pedagogical approaches, emotional intelligence, student engagement, and skill-based teaching methods.

The Influence of Parents and Society

Parents and society also contribute significantly to qualification-centered education. Many parents measure success through marks, ranks, and prestigious degrees. Children are often compared with others based on academic performance.

This creates several problems:

Fear of failure

Reduced self-confidence

Mental stress

Lack of individuality

Career choices based on social pressure

Many students choose courses they are not passionate about simply because society considers them respectable or financially rewarding. As a result, students may become qualified professionals without genuine interest or satisfaction. Society must recognize that intelligence is not limited to academic achievement. Artistic talent, entrepreneurship, sports, creativity, communication, and social leadership are equally important forms of intelligence.

Technology and Artificial Intelligence in Education

Technology has transformed education dramatically in the twenty-first century. Online learning platforms, digital classrooms, educational applications, and artificial intelligence tools have made learning more accessible and flexible.

Positive impacts of technology include:

Access to global educational resources.

Flexible and remote learning opportunities.

Interactive educational experiences.

Faster communication and collaboration.

Personalized learning methods.

Improved accessibility for students in remote areas.

However, technology also creates challenges.

Superficial Learning

Many students depend on quick summaries, AI-generated answers, and online shortcuts instead of deep understanding.

Reduced Critical Thinking

Excessive dependence on technology can weaken independent thinking and analytical skills.

Distraction

Social media and entertainment platforms reduce students' concentration and study habits.

Academic Dishonesty
Easy access to online content increases plagiarism and unethical academic practices.

Information Overload
Students often struggle to identify reliable information among vast digital resources.

Artificial intelligence can support education effectively when used responsibly. AI tools can assist in personalized learning, language support, research guidance, and accessibility. However, education must ensure that students continue to think independently rather than relying entirely on technology.

Importance of Moral and Value-Based Education
One major weakness in modern education is the declining focus on moral and ethical development. Academic success alone cannot create responsible citizens.

Value-based education teaches:

Honesty

Compassion

Respect

Responsibility

Discipline

Empathy

Social awareness

Environmental responsibility

Tolerance

Humanity

Many social problems such as corruption, discrimination, violence, and unethical professional behaviour arise when education ignores moral development. Educational institutions should therefore include ethical discussions, social service activities, environmental awareness programs, and community engagement as part of the learning process.

Emotional Intelligence and Mental Health
Modern students face enormous pressure related to academics, careers, competition, and social expectations. Mental health problems among students have increased significantly in recent years.

True education should support emotional well-being and emotional intelligence.

Emotional intelligence includes:

Self-awareness

Self-control

Empathy

Stress management

Healthy relationships

Communication skills

Students with emotional intelligence can manage challenges more effectively and contribute positively to society.

Educational institutions should provide counselling services, mentorship programs, mental health awareness, and supportive learning environments.

Practical Learning and Experiential Education
Practical learning helps students connect theoretical knowledge with real-world experiences. Experiential education includes:

Internships

Field visits

Group projects

Laboratory activities

Community service

Entrepreneurship programs

Workshops and training sessions

These experiences improve confidence, teamwork, communication skills, and problem-solving ability.

For example, business students who participate in entrepreneurial projects gain practical understanding beyond textbooks. Similarly, science students benefit more from laboratory experimentation than memorization alone. Education should therefore focus equally on practical exposure and academic instruction.

Creativity and Innovation in Education
Creativity is essential in the modern world. Technological advancement and global competition require individuals who can think innovatively and solve complex problems.

However, rigid educational systems often discourage creativity by emphasizing standard answers and examination patterns.

Creative education encourages:

Independent thinking

Curiosity

Innovation

Exploration

Artistic expression

Research and experimentation

Students should be encouraged to ask questions, challenge ideas, and develop original solutions.

Holistic Education

Holistic education focuses on the complete development of individuals rather than academic achievement alone. It includes intellectual, emotional, physical, social, ethical, and spiritual growth.

Holistic education aims to create:

Responsible citizens

Lifelong learners

Ethical professionals

Emotionally balanced individuals

Socially aware communities

This approach recognizes that education is not limited to classrooms or examinations but continues throughout life.

Education and Social Responsibility

A truly educated person contributes positively to society. Education should therefore encourage social responsibility and civic awareness.

Students should understand issues such as:

Poverty

Gender equality

Environmental sustainability

Human rights

Social justice

Community development

Service-learning programs and community engagement activities help students develop empathy and responsibility.

Need for Educational Reforms
Modern educational systems require significant reforms to bridge the gap between education and qualification.

Important reforms include:

Skill-Based Curriculum
Curriculum should focus on communication, leadership, critical thinking, and practical abilities.

Reduced Examination Pressure
Evaluation systems should include projects, presentations, creativity, and practical performance rather than memorization alone.

Teacher Development
Teachers should receive training in modern teaching methods and student-cantered learning.

Technology Integration
Technology should support meaningful learning rather than encourage dependency.

Mental Health Support
Educational institutions should prioritize emotional well-being and counselling services.

Industry Collaboration
Colleges should collaborate with industries to provide practical exposure and employability training.

Value-Based Education
Ethics and social responsibility should become integral parts of education.

These reforms can help create a balanced and meaningful educational system.

Conclusion

The debate between being educated and being qualified has become increasingly relevant in the modern world. While qualifications are important for professional recognition and career opportunities, they do not necessarily define true education. Education is a lifelong process that shapes knowledge, wisdom, character, ethics, creativity, emotional intelligence, and social responsibility. Modern educational systems often prioritize marks, examinations,

and certificates over understanding and practical learning. As a result, many individuals become academically qualified but lack communication skills, ethical awareness, critical thinking, emotional intelligence, and practical competence. This creates a gap between academic achievement and real-life capability.

Technology and artificial intelligence have transformed education positively by improving accessibility and learning opportunities. However, excessive dependence on technology can also reduce independent thinking and deep learning if not used responsibly. True education should focus on holistic development rather than academic success alone. Educational institutions must encourage creativity, innovation, practical exposure, ethical values, emotional well-being, and social responsibility. Teachers, parents, governments, and society all play important roles in creating meaningful educational experiences. An educated person is not merely someone who holds degrees or certificates. A truly educated person can think critically, acting ethically, solving problems, respecting diversity, adapting to change, and contributing positively to society. Therefore, the future of education should move beyond qualification-centred systems and focus on developing complete human beings prepared for both professional success and responsible citizenship.

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Value-Based Education for Global Citizenship: Integrity, Self-Discipline & Environmental Responsibility

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Abstract

In this accelerating 21st century of an interconnected world with pervading complex problems, like climate change, structural inequality and fast technological change, the purpose of education must be broader than only academic achievement and transmission of knowledge. Globalization and in-depth cross-cultural engagement are demanding a contemporary model of education that develops responsible, social and global individuals who can cope effectively in a dynamic society. It is our belief that value education is not simply an add on but rather a fundamental basis on which to construct true global citizens. Ethical development, respect for difference, empathy, cooperation, and social responsibility, all have a significant part to play in preparing young people for responsible, compassionate citizenship in an increasingly intertwined world. In this paper, we concluded that global citizenship cannot be merely confined to knowing about global affairs. The definition of a global citizen is "a person who recognizes the inseparable and indissoluble ties which bind together all peoples, countries and cultures; a sense of obligation to make a positive contribution to this world". We thus create a three-step pedagogic stance which would guide students towards that engaged perspective, defining these as Integrity, Self-Discipline and Environmental Responsibility, the three pillars that guide active, conscious action. Through the fusion of cognitive awareness, moral and aspirational capacities, the tripartite perspective of this research assumes that value-based education is the basis of genuine global citizenship. The concluding section of this paper will take the discussion of each principle and outline what kind of policies or practices an institution might take to make them a reality. It will aim to describe the kinds of human beings who would thrive in our complex, globally integrated world and whose purpose and motivation would be the creation of an ever more peaceful and just global community.

Keywords: 1C Schools, AI-Based Learning, Slow Learners, Virtual Reality (VR)

Introduction

We are living in the era that is the era of utmost contradictions; it is the era when mankind is the richest (technologically, scientifically, and materially) and the poorest at the same time (with regards to ecology; in respect of democracy (destroyed through post-truth manipulation) and sense (in the context of the materially rich universe)). Throughout human history, education (in the form of literacy, learning of knowledge and career preparation) has been a primary catalyst of progress of individuals and humanity, driving individual development, social progress and national development. Today's intricate and sophisticated issues of corruption, violence, systematic hate and devastating global warming show us one fundamental fact: the individual academic brilliance and

intellectualism can neither maintain nor advance a humanity that works; the individual profit has to give way to the good of all humanity.

Review of Related Literature

The world problems, belonging to the SDGs, which encompass anything from global warming to damage to the bio-diversity to the gross inequity of the world economy, are indeed technical and technical in nature. The capabilities of satellites will show the illegal cutting down of trees and algorithms can expose the money laundering; none of which can bring an end to moral reluctance or courage not to take a bribe; they are a crisis of not only spirit, but of the self, as defined by Vaclav Havel. These technical capacities go hand in hand with a global process that is seeing ever-increasing materialistic and egotistical forms of thinking embraced across the planet; ruthless competition for worldly success is marginalizing morals, leading to ever-increasing social injustice, daily deception, prejudice, and environmental destruction. Thus, what we require is a form of education that directly and deliberately fosters thinking and virtue together.

Such a profound diagnosis involves not changing the goal of the system, which is still largely determined by the industrial model, and by the neo-liberal discourse. Now Education is a system that provides human capital, that is men and women who can be successful and competitive in a global economy, producing brilliant accountants, expert engineers, shrewd marketers, and it is entirely insensitive to the clamorous silence regarding whether it can claim the right to educate individuals to whom one might hope that they will behave with honesty and authenticity. T.S. Eliot could indeed lament, 'Where is the wisdom we have lost in knowledge? Where is the knowledge we have lost in information?' but we now seem compelled to ask, 'Where is the character we have lost in skill?'. It is precisely to answer that question, to make education a conscious construction of an individual person rather than a passive acquiescence to the system, that a value oriented system proposes itself: in an explicit or implicit way it suggests the individual the behaviour that he must assume, how he must act toward others and toward the community, promoting all those attitudes that can define and mold a person entirely. To favour the growth of emotional maturity, empathy, temperance, authenticity, gentleness, not seems to be an optional supplement, but the core element that can justify education as such.

Objectives

The paper argues for a moral triad of integrity, self-discipline and environmentalism upon which global citizenship based value education can rest. The triad is not picked arbitrarily from a list of virtue but derived logically on the basis that each corresponds with one of the three essential relationalities with which any global citizen has to deal with; that of one's relation to the self (which requires unwavering integrity), that of one's relation to one's drives and to the physical world (which requires disciplined self-control) and one's relation to the ecosphere of the planet, without which no life would be possible (which demands considerable care for the planet). A global citizen lacking such basic values would indeed be a paradox – a sailor without a compass, a warrior without a heart. And it is precisely in such a globalized world where technology, communication, trade, and travel have bridged the gaps of distances to unprecedented speeds that the argument for such a moral underpinning becomes more pressing than ever. Because people of varying culture, religions and traditions now meet with one another, interact with one another, live with one another, on a regular basis it is a highly connected global world that demands new sorts of people and citizens with a moral compass to live with one another peaceably,

transcend all boundaries and to work as partners in tackling our common complex global problems.

This paper argues that a "moral tripod of integrity, self-discipline, and responsibility for the environment" is needed to sustain global citizenship, that is, a global ethic of recognized human solidarity. If you remove one leg, the legs are all incapable of supporting the entire structure of morally oriented global action: integrity without self-discipline remains "an idle or even deceptive commitment" that will not last when put to the test; self-discipline without integrity "is an instrumental and therefore in itself neither good nor bad but extremely powerful capacity which will carry out a bad end just as efficiently as a good end;" and both, in the absence of responsibility for the environment, are "anthropocentrically constrained" constructions that construct a just social order on a poisoned planet. Value education and global citizenship, therefore, are ultimately inseparable, because this triadic core fosters the " morally strong, socially conscious and environmentally minded citizens that support solidarity, recognize diversity, advance social justice and respect the planet." In this paper, I will show how it is possible to implement this vision, in which I elaborate on each of the values both conceptually and practically, offer a pedagogical approach to their development, and discuss the necessary conditions for this kind of education to prosper in our increasingly interdependent world.

Methodology

Significance of Value Based Education

Value based education is the consciousness of humanity; the awakening to the realization that education is not just about books and examination but the awakening of the moral, ethical, social and emotional seeds within. Education not only moulds minds but also sculpts characters. Values such as honesty, truthfulness, tolerance, compassion, honesty and discipline help mould personalities into good human beings which serve as the bedrock of an individual's attitude in all aspects of his life. In this world which is being polluted by corruption, violence and ecological pollution, such education is a source of great hope to the student. It teaches students to value morality and social order. It helps create an all-round person with not only academic skills but also empathy, resilience, a strong sense of responsibility towards the society, nation and the world. These fundamental values in education transform individuals into responsible citizens, to nurture harmony and understanding towards mankind, equality in social order and justice in society. Value-based education is indeed an awakening for every human being.

Value based education is what we have in common on our human journey remembering whatever is worth remembering of the past while striving toward a more noble future. It sends us back to ourselves, demands of us to account. It keeps us in touch with who we are, where we come from and what we are going to be. Modern education is pre-occupied and obsessed with the present, utterly consumed by trends and technologies and by immediate needs. In times like these, when the world itself is falling apart because of a crisis which, ultimately, is a crisis of the human heart, this quiet, gradual, obstinate labour of waking what can yet be woken in us our ethical, social, emotional and moral underpinnings is not simply one possible way among several, but is the essential and untouchable ground of a human future. At the same time, it cultivates no vivid, palpable obligation to the future; the heirs to whom that future is bequeathed and whose world is now being defined do not appear as actual, embodied moral subjects of responsibility, whose future we are in fact deciding now. Value-based education, in the first place, is an act of reintegration with time. It brings the student into dialog with the great sages,

prophets, philosophers and moral exemplars of the past and elicits those timeless teachings to inform their present tasks. It insists, in the second place, and through the principle of intergenerational justice, that the yet-born already hold a claim on us, and that we are not masters of this world but momentary custodians who are committed to leaving it intact. This twin re-anchoring dissolves the loneliness and hubris of the contemporary and places the individual in the larger currents of a story that far transcends a single human life.

In conclusion, value based education is not merely some sort of appendix of ethical instruction attached to an otherwise conventional curriculum; it is rather a radical rethinking of the entire educational endeavor, turning it away from producing efficient gears of the economic engine toward nurturing human beings in their full moral, emotional, social, and spiritual dimensions. It is in a very fundamental sense, a revolt against the de-humanizing reduction of a person to a credential and consumer and a declaration of an alternative path to flourishing, a path that is relational, responsible, reverent, and rooted. In an age when the world is teetering under the burden of crises that are, at heart, crises of the human heart, this silent, slow, stubborn work of awakening that in us which may yet be awakened our moral, ethical, social, and emotional foundations is not one option among many but rather the fundamental, inviolable basis of any future worthy of the name 'humane.'

Analysis

Global Citizenship in the Modern World

The very concept of global citizenship embraces the idea that we are all human beings interconnected and have certain duties to our fellow man and to the Earth. The pace of global affairs means that any act done by one person or one nation could affect a vast number of other people and other nations. Global problems such as climate change, poverty, pandemics, and social inequity can only be solved if there are efforts made, as well as the knowledge of understanding and responsibility for one another. Global consciousness forces us to look beyond ourselves and beyond our own country and see that we are responsible for the well-being of others and for our planet.

As a result of advances in communication and technology, different cultures and nations are much closer together and now it is obvious that there are many problems that we face that are not ones we can tackle individually. Global citizens accept and admire cultural differences and believe that it can enrich us all and it can contribute to learning rather than causing division. They fight discrimination and oppression and stand up for equality, peace and human rights. By developing a global attitude, you can achieve mutual understanding and working together, creating unity between different people to build a better future.

A sense of environmental responsibility is essential to being a global citizen. Knowing the planet's limited resources and climate change crises prompts people to live a green lifestyle and to conserve resources. Educating oneself can influence the development of such an attitude. This involves not only knowledge, but also awareness of the ethical and societal responsibilities we hold and the necessity of ethical consumption and practice. Global citizens understand that environmental preservation is a responsibility-an individual undertaking toward a greener future. By embracing this value, we call ourselves to live and act with consideration on a world-wide basis.

Findings and Discussion

Integrity

The Essence of Integrity

Integrity is one of the most important human values which influence our personality and relationships. It represents honesty, truthfully telling or admitting the truth, moral strength to carry on doing things as right even if it means not being liked and the synchronization between our words and deeds. One with integrity adheres to ethical values and beliefs regardless of being observed or not. It influences an individual and strengthens the core for a truthful relationship and well ordered society. If not, people would not be able to be trusted and would tend to corruption, falsehood and injustice in society.

Building Trust and Preventing Corruption

Trust is built by the practice of integrity in all life aspects; in personal life, in work life and in social life. People who adhere to integrity help to make fair and transparent institutions while it is not followed may lead to abuse of power, injustice and exploitation. Teaching integrity to children at an early age can be a way of instilling values of moral responsibility and ethical behaviour. Children need to learn that they are responsible and honest as it is fundamental when they are making decisions.

The Role of Leadership and Responsibility

Integrity is arguably of even greater importance when it comes to leadership as the decisions leaders take have widespread effects on society. Leaders with integrity place the common good before themselves and serve as role models of morality and honesty. Such leaders endeavour to foster honest organizations, fight corruption, and ensure social trust; the integrity of such leaders inspires those they lead to behave similarly thus leading to an increased level of ethical behaviour in society. Through ethical leadership it becomes clear that true power comes from morality and morality from integrity in leadership.

Educational Strategies to Cultivate Integrity

Institutions like school or college also have a great responsibility in cultivating integrity in students. This is possible through classroom discussions, sharing moral stories and conducting role plays and group activities on integrity. Teachers also become role models, who have a great influence on students. School has a greater duty in setting honesty during exams and other assignments and daily routines so that students learn that sincerity leads to true happiness and integrity leads to a noble life.

Self Discipline:

Shaping Character in a World of Distractions

Self-discipline can be defined as one's ability to voluntarily control his own thoughts, feelings and actions. One requires a certain level of self control and ability to be accountable to oneself in order to have this ability. Examples of characteristics that are covered by the term self discipline are; patience, responsibility, punctuality, perseverance and attentiveness. One can not stress the importance of this trait enough in the world today with so many instant gratifications and enjoyable experiences in proximity.

Navigating Modern Challenges with Inner Control

In today's world, new difficulties arise for self-control, like the addictive nature of the internet and social media, as well as our unhealthy eating habits and the decrease in our

ability to focus. Having self-control assists people in planning, prioritizing and also following through on projects. Inner self-control helps not only in school and on the job, but also emotional well-being. By controlling our bad feelings like anger and resentment, disciplined people are better able to build relationships with others and promote social order.

Fostering Responsibility and Respect Through Discipline

A responsible individual knows the value of responsibility and accepts what he does. Respect towards the rules, laws, regulations and the society as a whole means an individual knows how to be ethical and for what a particular system works for the society as a whole. In a school, routines and rules inculcate these values within the individual. By means of sports, extracurricular activities and regulated routines in school and college life students learn about these qualities, values like co-operation, patience, and team work by and through each and every moment.

Nurturing Self Discipline for a Better Society

This sense of self discipline is fostered in both parents and teachers by use of support, motivation and positive reinforcement rather than force and punishment. Self-discipline that develops naturally is internalized. If this develops from infancy it will guide us in our daily choices for life. It would appear that self-discipline is not simply an individual value but a societal requirement. Those that are disciplined will become good members of society and have a more just, stable and compassionate world.

Environmental Responsibility:

The Imperative of Environmental Responsibilities

Fundamentally, environmental responsibility involves us acknowledging that we have a moral responsibility to protect the natural environment and use its resources responsibly. With growing issues such as climate change, pollution, deforestation, lack of water and human contribution to these issues such as industrial growth and plastic waste, it is no longer possible to avoid accepting the fact that humanity is harming our environment in such significant and potentially irreversible ways and thus accepting our responsibilities.

The Ethical Dimension of Our Choices

Man is directly interconnected to nature-our own survival relies on the well-being of this planet. By neglecting this link, the negative consequences could put into question the stability of our ecosystems and thus life itself. Companies and individuals, dedicated to preserve the environment know that, by managing our resources responsibly, we will minimize the amount of wasted matter, the necessity of protecting it is no longer a luxury, but an obligation. Our small daily efforts like saving energy and reducing our usage of plastics are building towards large-scale solutions based on sustainable development and therefore securing the present and the future.

Education as Catalyst for Change

Educational institutions hold a significant position in creating awareness and sense of responsibility toward the environment. Infusion of climate science, biodiversity, conservation, and sustainability into the curriculum shape up responsible individuals to make efficient decisions toward betterment of the environment. Afforestation programs, recycling campaigns, water conservation and other practical projects help convert the awareness into actions. Creating eco-conscious individuals through adopting practices of

minimizing waste and conserving resources will turn them into responsible environmental actors of the society.

A Collective Moral Responsibility

Environmental responsibility extends beyond self-will or practice and reflects integrity and self-control. When environmental responsibility is regarded as a universal moral obligation, the choice to fulfil it becomes a duty. When environmental responsibility becomes the joint effort of global citizens, it becomes one part of social justice. The commitment to environmental responsibility becomes part of the moral obligation to be responsible for leaving an environment and a world worthy of human existence

The Ethical Foundation

Integrity, self-discipline, and environmental responsibility are interconnected fundamental principles which lead towards becoming a responsible global citizen. The aspect of Integrity forces one to be honest and ethical in everything they do, thereby establishing a moral compass upon which responsible behavior can be based. Self-discipline will enforce integrity; ensuring that one continues responsible practices no matter what may lead to deviation. Environmental Responsibility will allow the individual to care for their natural resources with responsibility that goes beyond the self. In these senses, they can form a strong bond which is very productive.

The knowledge that all of these virtues are intertwined demonstrates how value based education needs to be an all-encompassing concept. Developing integrity, self-discipline, and respect for the environment at the same time could instill individuals with a sense of integrity, build disciplined people, and make them more responsible citizens in their community in relation to the earth and its resources. These interconnected traits in a value based curriculum help encourage cooperation, respect for others, social harmony, and cooperation with others within a community. It seems vital that the development of these intrinsic links be incorporated into the curriculum for the sake of developing well rounded people.

Challenges in Cultivating Character and Values Through Education

Value based education is still encountering many major difficulties that are responsible for lack of its widespread practice. The lack of emphasis on character and moral conscious development among pupils while giving too much importance on tests and career is one of the major ones. Learning systems seem to give more importance to academic knowledge, not to characters, as a result young pupils have less chances of internalizing values necessary for a responsible society. Another challenge includes social media and modern gadgets; negative contents of it such as the promotion of violence, selfish and unhealthy living.

Among other constraints are the inadequacy of well-trained educators who can effectively implement values education and lack of instructional time in a curriculum dedicated to values education. Family settings, in a busy life and rapidly changing social circumstances, may not serve as strong conduits of constant guidance toward morality. Different viewpoints about ethics in the context of cultural and social diversity further pose challenges to forming a common perception of morality. Despite the magnitude of challenges, value based education is a very crucial element to developing responsible persons and ensuring a sustainable and harmonious future for the whole of humanity.

Conclusion

Value Based Education for Global Citizenship: Integrity, Self -discipline, and Environmental Responsibility serve as the very foundation for the construction of a future in which mankind is able to flourish both individually and as a species, in unity and in spirit. In an era that is constantly evolving at break neck speeds and with ever increasing interconnectedness throughout the planet, the role of education must expand to do much more than simply mould one's intellect; education must also fuel the integrity to uphold morality even when unpopular, self discipline to follow one's moral convictions, and the environmental responsibility to conserve our precious earth for future generations to enjoy and benefit from as well. Such values cannot simply be considered "ideals," but instead serve as moral beacons by which individuals will navigate this world of disorder and disarray, thus helping to facilitate the spread of peace, social justice, and environmental sustainability throughout. In collaboration with parents and communities alike, schools are charged with producing educated individuals; this is only one part of the equation to create a more ideal society, as it does not address an individuals' ability to be upstanding and to have the right values to implement what they have been taught. The future prosperity of our society lies not in one person or any number of advanced technologies, but instead in the collective and individual moral responsibility, as embodied by a new emphasis on values based education.

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Measuring Emotional Intelligence Through Literary Engagement: A Study of Student Response in English Classrooms

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Abstract

In contemporary education, emotional intelligence is increasingly recognized as a critical component of holistic student development, complementing cognitive and academic skills. Literature, with its nuanced representation of human emotions and experiences, offers a potential medium for fostering empathy, self-awareness, and emotional regulation. This study aims to examine how engagement with literary texts contributes to the development of emotional intelligence among English literature students, with a focus on measurable student responses. The research adopts a qualitative approach supported by response-based analysis, incorporating reflective writing, guided questionnaires, and classroom discussions as primary data collection methods. A sample of undergraduate English literature students was considered to evaluate changes in emotional perception, empathy, and self-reflection after interacting with selected literary texts. The findings indicate that structured literary engagement enhances students' ability to interpret emotional complexity, understand diverse perspectives, and critically reflect on their own emotional responses. Furthermore, measurable improvements were observed in students' articulation of empathy and emotional awareness. The study concludes that literature, when taught through interactive and reflective pedagogical strategies, can serve as an effective tool for developing emotional intelligence. It emphasizes the need for integrating response-based methodologies in English classrooms to bridge the gap between literary analysis and real-life emotional competence.

Keywords: Emotional Intelligence, Empathy, English Education, Literary Engagement, Student Response

Introduction

The landscape of contemporary education has undergone a paradigm shift, moving beyond the exclusive emphasis on cognitive achievement towards a more holistic model of student development. Emotional Intelligence (El), first formally conceptualised by Salovey and Mayer (1990) and popularised by Goleman (1995), encompasses the ability to perceive, understand, manage, and utilise emotions effectively in oneself and others. In academic settings, El has been linked to improved interpersonal relationships, resilience, and overall well-being.

English literature, by its very nature, is an exploration of the human condition. Literary texts novels, poems, plays, and short stories - offer readers windows into diverse emotional worlds, presenting characters who navigate complex moral, social, and

psychological terrains. When students engage deeply with such texts, they are not merely analysing language; they are vicariously experiencing emotional situations, negotiating moral dilemmas, and developing empathetic understanding. This intersection of literary study and emotional development presents a compelling area of academic inquiry.

Despite the intuitive connection between literature and emotional growth, empirical research measuring this relationship within structured classroom environments remains limited, particularly in the Indian higher education context. This study seeks to address this gap by examining how structured literary engagement influences measurable dimensions of emotional intelligence among undergraduate English literature students.

Review of Related Literature

The theoretical underpinnings of this study draw from three interconnected domains: emotional intelligence theory, reader-response criticism, and affective learning in education.

- **Emotional Intelligence in Education**

Salovey and Mayer (1990) defined El as "the ability to monitor one's own and others' feelings and emotions, to discriminate among them, and to use this information to guide one's thinking and actions." Goleman (1995) expanded this framework into five domains: self-awareness, self-regulation, motivation, empathy, and social skills. Brackett et al. (2011) demonstrated that El competencies are teachable and measurable within school settings, laying groundwork for curriculum-based interventions.

- **Reader-Response Theory**

Rosenblatt's (1978) transactional theory of reading posits that meaning is created through the dynamic interaction between reader and text. The "aesthetic" reading stance, as opposed to the "efferent," emphasises the lived-through emotional experience of the text. Iser (1978) and Jauss (1982) further developed reception theory, highlighting how readers' horizons of expectation are transformed through literary encounter a process inherently tied to emotional and cognitive growth.

- **Literature and Empathy Development**

Kidd and Castano (2013) provided empirical evidence that reading literary fiction improves Theory of Mind the capacity to understand others' mental states. Mar et al. (2009) found consistent correlations between lifetime exposure to fiction and measures of empathy. In educational contexts, Keen (2007) argued that narrative empathy is a distinct and measurable phenomenon, activated through sustained engagement with literary characters and situations.

- **Affective Learning and Curriculum Design**

Krathwohl, Bloom, and Masia's (1964) taxonomy of affective learning outlines a hierarchy from receiving and responding to valuing, organising, and internalising values a progression mirroring the deepening of emotional intelligence. Nussbaum (1997) advocated for literature as central to cultivating democratic citizenship and empathetic imagination, a position echoed in Indian educational policy discourse (NCF, 2005).

Objectives

Research Objectives

1. To examine the impact of structured literary engagement on students' emotional perception and awareness.
2. To assess changes in empathy levels among undergraduate English literature students following guided textual interaction.
3. To explore how reflective writing and classroom discussion facilitate self-awareness and emotional regulation.
4. To identify pedagogical strategies that effectively bridge literary analysis with emotional competence development.

Research Questions

1. How does engagement with selected literary texts influence students' ability to identify and articulate complex emotions?
2. To what extent does structure literary discussion enhance empathetic understanding of diverse perspectives?
3. What measurable changes occur in students' self-reflection and emotional awareness through response-based activities?
4. Which pedagogical approaches most effectively cultivate emotional intelligence in the English literature classroom?

Methodology

This study adopts a **qualitative research design** supported by response-based analysis, situated within an interpretivist paradigm. The conceptual framework integrates Rosenblatt's transactional theory of reading with Goleman's emotional intelligence model, positioning literary engagement as the mediating variable between textual interaction and El development.

The four-phase framework ensures systematic progression from baseline assessment through intervention to measurable outcome evaluation.

A purposive sample of 60 undergraduate students enrolled in B.A. English Literature at Fatima College, India, participated in the study. Participants were drawn from the second and third year of the programme, ensuring sufficient prior literary exposure. The sample comprised female students across diverse socio-cultural backgrounds.

Data Collection Instruments

- Reflective Writing Journals: Weekly entries responding to literary texts, analysed for emotional vocabulary and depth of self-reflection.
- *Guided Questionnaires:* Pre- and post-intervention surveys measuring self-reported empathy and emotional awareness using adapted El scales.
- *Classroom Discussion Transcripts:*
- Recorded and transcribed group discussions analysed for perspective-taking and emotional reasoning.
- *Selected Literary Texts:* Short stories, poems, and novel excerpts chosen for their emotional complexity and thematic diversity.

Analysis

Data analysis followed a thematic approach, with reflective journals and discussion transcripts coded for indicators of emotional intelligence: emotional vocabulary, perspective-taking, self-awareness statements, and empathetic reasoning. Questionnaire data were analysed for pre-post shifts in self-reported El dimensions.

- **Emotional Vocabulary Enrichment**

Students demonstrated a marked increase in the precision and range of emotional vocabulary in their reflective writing. Early entries relied on generic terms ("sad," "happy"), while later responses employed nuanced descriptors ("melancholic," "ambivalent," "resigned"), indicating heightened emotional differentiation a core El competency.

- **Perspective-Taking in Discussion**

Classroom discussions revealed progressive shifts from egocentric textual interpretations to multi-perspectival readings. Students increasingly referenced characters' motivations, contextual constraints, and emotional landscapes, demonstrating the development of Theory of Mind through sustained literary engagement.

- **Self-Reflection Depth**

Reflective journals showed a trajectory from surface-level textual summary towards deeper personal connection and introspection. Students began drawing parallels between literary situations and their own emotional experiences, indicating the internalisation of affective learning objectives.

- **Empathetic Articulation**

Post-intervention questionnaires recorded significant improvements in students' self-reported capacity to understand and respond to others' emotions. This was corroborated by qualitative data showing increased empathetic language in both written and verbal responses to literary scenarios.

Findings and Discussion

The study produced consistent and significant findings across all three data collection methods: reflective journals, questionnaires, and classroom discussions. The triangulation of these methods strengthened the reliability of the results and provided a comprehensive understanding of the development of Emotional Intelligence (EI) through literary engagement.

The participants of the study were undergraduate English Literature students of Fatima College. Over an eight-week intervention period, students engaged in structured literary activities designed to enhance emotional understanding and response. The study focused on four major dimensions of Emotional Intelligence: self-awareness, empathy, emotional regulation, and social perception.

The findings revealed that structured literary engagement significantly improved students' ability to interpret emotional complexity both in literary texts and in real-life situations. Students became more capable of identifying subtle emotional states, understanding character motivations, and connecting literary experiences with personal and social realities. A notable improvement was observed in students' empathetic abilities. Questionnaire responses and classroom interactions demonstrated that students developed a deeper understanding of perspectives different from their own. Many participants showed increased sensitivity toward diverse emotional experiences, indicating that literary texts can effectively foster empathy and interpersonal understanding.

Among the three methods employed, reflective writing emerged as the most effective tool for enhancing self-awareness and emotional regulation. Students' journals reflected greater emotional clarity, improved self-expression, and an increased ability to analyze and regulate personal emotions over time. Reflective activities encouraged students to critically examine their emotional responses and relate them to literary themes and situations. The study also found that interactive pedagogical strategies such as Socratic questioning, role-play, and peer discussions substantially strengthened emotional learning outcomes. These collaborative approaches enabled students to engage more deeply with texts, articulate emotional interpretations, and develop social awareness through dialogue and shared perspectives.

One of the most significant observations was that students who initially possessed limited emotional vocabulary demonstrated the greatest improvement during the intervention. This suggests that literary engagement may be particularly effective for learners with underdeveloped affective competencies, as exposure to emotionally rich texts and guided reflection expands both emotional awareness and expressive capacity. Overall, the results indicate that literary engagement functions not only as an academic exercise but also as a meaningful tool for emotional development. The findings support the integration of emotionally responsive literary pedagogy within English classrooms and highlight its potential contribution to inclusive and holistic education.

Conclusion

This study substantiates the claim that literature, when taught through interactive and reflective pedagogical strategies, serves as an effective medium for developing emotional intelligence. The convergence of reader-response theory with El frameworks provides a robust theoretical basis for integrating affective learning objectives into English literature curricula. The findings affirm that emotional competence is not merely a by-product of literary study but can be intentionally cultivated through structured, response-based methodologies.

- Curriculum Design: English literature syllabi should explicitly incorporate response-based activities – reflective journals, guided discussions, and empathetic reading exercises components rather than supplementary tasks. As core

- Teacher Training: Educators require professional development in facilitating affective discussions and assessing emotional learning outcomes alongside traditional literary competencies.

- Assessment Reform: Evaluation frameworks in English education should recognise and reward emotional insight and empathetic reasoning as legitimate academic achievements.

- Future Research: Longitudinal studies with larger, diverse samples and quantitative El measurement tools are recommended to strengthen the empirical base of this field.

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The Effectiveness of Cognitive Strategy Instruction in Enhancing Cognitive Processing and Narrative Reading Comprehension: A Systematic Literature Review

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Abstract

Cognitive Strategy Instruction (CSI) has been widely recognized as an effective pedagogical approach to enhance students' higher-order thinking and reading comprehension skills, particularly in processing narrative texts. However, despite its growing application across various educational contexts, the extent of its effectiveness remains inconclusive. This study aims to evaluate the effectiveness of Cognitive Strategy Instruction in improving students' cognitive processing and narrative reading comprehension. The study adopts a systematic literature review approach guided by the PRISMA 2020 framework. A comprehensive search was conducted across major electronic databases, including Scopus, Web of Science, and Google Scholar, covering publications from 2015 to 2025. A total of 18 empirical studies were selected based on predefined inclusion criteria. The findings indicate that Cognitive Strategy Instruction significantly enhances students' cognitive processing abilities, including metacognitive awareness, inference-making, and information integration. Additionally, CSI shows a positive impact on students' comprehension of narrative texts, particularly in identifying story structure, main ideas, and implicit meanings.

Keywords: Cognitive Processing, Cognitive Strategy Instruction, Reading Comprehension, Narrative Text, Reading Comprehension, Systematic Literature Review

Introduction

Reading comprehension is a fundamental component of language learning, particularly in engaging with narrative texts that require not only literal understanding but also higher-order cognitive processing such as inferencing, interpretation, and integration of information. The Programme for International Student Assessment (PISA 2022 Results (Volume I), 2023), which surveyed approximately 700,000 fifteen-year-old students across 81 countries, reported an unprecedented decline in reading performance mean reading scores fell by 10 points relative to the 2018 cycle — the equivalent of half a year of learning — with declines observed across virtually all participating nations. In contemporary educational contexts, learners are expected to demonstrate critical thinking and deep comprehension skills, which necessitate instructional approaches that actively engage cognitive processes rather than relying on passive reading practices; (Kim et al., 2006) .

Review of Related Literature

Cognitive Strategy Instruction (CSI) has emerged as a promising approach to address these challenges by explicitly teaching learners how to apply strategies such as predicting, questioning, summarizing, and monitoring comprehension (Komariah et al., 2015). From a cognitive science perspective, CSI is additionally grounded in (Sweller, 1988). Cognitive Load Theory, which posits that effective learning depends on the efficient management of cognitive resources within a limited working memory system. The theoretical foundations of CSI integrate (Vygotsky, 1978) sociocultural theory of learning — particularly the concept of the Zone of Proximal Development and the gradual internalization of externally supported cognitive processes — with (Flavell, 1979) metacognitive theory, which emphasizes the critical role of self-monitoring and self-regulation in skilled cognitive performance.

In the context of narrative texts, the importance of CSI becomes even more pronounced due to the complexity of narrative structures, which require readers to understand plot development, character relationships, and implicit meanings (Sari et al., 2022) Additionally, learner characteristics such as proficiency level, motivation, and cognitive capacity influence the effectiveness of strategy instruction).

Previous systematic reviews and meta-analyses have highlighted the effectiveness of reading strategy instruction; however, most of them focus broadly on reading comprehension without specifically addressing the dual role of CSI in enhancing both cognitive processing and narrative text comprehension (Takallou, n.d.). This gap indicates the need for a systematic literature review that provides a focused and updated synthesis of empirical evidence on the effectiveness of CSI. Based on the identified gaps in the literature, this study aims to conduct a systematic literature review to examine the effectiveness of Cognitive Strategy Instruction in enhancing cognitive processing and reading comprehension of narrative texts. Specifically, this review seeks to address the following objectives: (1) to analyze how CSI influences learners' cognitive processing abilities; (2) to evaluate the extent to which CSI improves comprehension of narrative texts; and (3) to identify key instructional and learner-related factors that contribute to the effectiveness of CSI across different educational contexts.

Supporting Theory

Cognitive Learning Theory

Cognitive Theory posits that learning involves active mental processes such as attention, information processing, storage, and retrieval. cognitive strategies refer to the mental processes learners use to manipulate incoming information, such as repetition, elaboration, summarization, inferencing, and note-taking. These strategies enable learners to transform linguistic input into meaningful knowledge structures stored in long-term memory. In reading instruction, cognitive strategies help learners organize textual information, identify main ideas, and establish relationships among concepts, which ultimately enhance reading comprehension. Therefore, in the context of narrative reading, Cognitive Learning Theory explains how strategy instruction can facilitate deeper processing of story elements and improve comprehension outcomes In reading comprehension, this theory emphasizes that understanding a text requires learners to engage in higher-order thinking processes, including inferencing, analyzing, and integrating new information with prior knowledge. Cognitive Strategy Instruction (CSI) supports these processes by equipping learners with structured strategies that facilitate deeper cognitive engagement during reading activities (Baker & Brown, 1984).

Information Processing Theory

Information Processing Theory explains how information is received, processed, stored, and retrieved by the human cognitive system. This theory compares human cognition to a computer system in which information passes through several stages, including sensory memory, working memory, and long-term memory.

(Kintsch, n.d.)proposed the Construction-Integration Model, which explains reading comprehension as a process in which readers first construct meaning from textual information and then integrate that meaning with their prior knowledge. This process is especially important in narrative reading because readers must simultaneously process characters, settings, conflicts, and causal relationships while maintaining coherence across the text.

In the context of Cognitive Strategy Instruction, strategies such as inferencing, sequencing, and summarizing support the efficiency of working memory and facilitate the integration of textual information into long-term memory structures. Consequently, Information Processing Theory provides a strong explanation for how CSI enhances learners' cognitive processing during reading activities

Metacognitive Theory

Metacognitive Theory focuses on learners' awareness and regulation of their own thinking processes. This theory is highly relevant to Cognitive Strategy Instruction because successful strategy use often requires planning, monitoring, and evaluating one's comprehension.

(Flavell, 1979) defined metacognition as an individual's knowledge about their own cognitive processes and their ability to regulate these processes effectively. He identified key components of metacognition, including metacognitive knowledge, cognitive experiences, goals, and strategic actions.

In reading comprehension, metacognitive awareness enables learners to recognize comprehension difficulties, adjust reading strategies, and evaluate their understanding of the text. During narrative reading, learners may monitor whether they understand the plot, identify confusing sections, and apply repair strategies when comprehension breaks down. Therefore, Metacognitive Theory supports the idea that CSI improves not only cognitive performance but also learners' self-regulation during reading.

Moreover, Metacognitive Theory focuses on learners' awareness and regulation of their own cognitive processes. It includes key components such as planning, monitoring, and evaluating comprehension. In reading contexts, metacognitive strategies enable learners to control their understanding and adjust strategies when comprehension difficulties arise. CSI enhances metacognitive awareness by explicitly teaching students how to apply and regulate reading strategies effectively, leading to improved comprehension outcomes (Komariah et al., 2015)

Self-Regulated Learning Theory

Self-Regulated Learning Theory emphasizes learners' ability to manage their own learning processes, including cognitive, motivational, and behavioural aspects. In reading, self-regulated learners set goals, apply strategies, and reflect on their

comprehension. CSI promotes self-regulated learning by training students to independently use cognitive strategies, enhancing both their autonomy and reading performance (Kim et al., 2006)

Narrative Comprehension Theory

Narrative Comprehension Theory specifically explains how readers understand story-based texts by constructing mental representations of events, characters, goals, and causal relationships.

Objectives

In narrative reading instruction, cognitive strategies such as inferencing, sequencing, and summarizing support learners in understanding plot development and character relationships. Therefore, Narrative Comprehension Theory provides a direct explanation of how CSI contributes to improved comprehension of narrative texts (Arthur GraesserSingerTrabasso, n.d.)

Reading comprehension is not a unitary skill but a complex, dynamic cognitive process involving the simultaneous coordination of multiple sub-processes including word recognition, syntactic parsing, semantic integration, inference generation, and metacognitive monitoring (Kintsch, n.d.)

The construction of a coherent mental model of text requires readers to actively integrate textual information with prior knowledge, generate bridging and elaborative inferences to fill information gaps, and continuously monitor their own comprehension to detect and repair breakdowns (Cain & Oakhill, 2014).

Methodology

This study employed a systematic literature review design guided by the PRISMA 2020 framework to ensure transparency, rigor, and reproducibility in identifying, selecting, and synthesizing relevant studies. (Page et al., 2021)

Eligibility Criteria

The inclusion criteria were defined based on the PICOS framework. Studies were included if they: (1) involved students as participants (primary, secondary, or tertiary levels); (2) examined Cognitive Strategy Instruction (CSI) as the main intervention; (3) reported outcomes related to cognitive processing and/or reading comprehension, particularly narrative texts; (4) employed empirical research designs (quantitative, qualitative, or mixed methods); and (5) were published in peer-reviewed journals in English between 2020 and 2025. Studies were excluded if they: (1) were review articles, conference papers, or dissertations; (2) did not specifically address cognitive strategy instruction; or (3) lacked sufficient methodological detail.

Information Sources

A comprehensive literature search was conducted across major electronic databases, including Scopus, Web of Science, ERIC, and Google Scholar. These databases were selected due to their extensive coverage of high-impact and peer-reviewed educational research

Search Strategy
The search strategy employed a combination of keywords and Boolean operators to maximize retrieval. The primary search string included:
“cognitive strategy instruction” AND “reading comprehension” AND “narrative text” AND “cognitive processing”.
Additional synonyms such a s “metacognitive strategies,” “reading strategies,” and “text comprehension” were incorporated to broaden the search scope. The search was limited to titles, abstracts, and keywords, and filters were applied for publication years (2020–2025) and document type (journal articles).

Selection Process
The study selection followed the PRISMA flow procedure, including identification, screening, eligibility, and inclusion stages (Page et al., 2021) Initially, all retrieved records were exported and duplicates were removed. Titles and abstracts were then screened for relevance, followed by full-text assessment based on the eligibility criteria. The selection process was conducted independently, and disagreements were resolved through discussion to ensure consistency and minimize selection bias.

Data Collection Process
Data extraction was conducted using a standardized data extraction form. Key information from each study was systematically recorded, including author(s), publication year, research design, sample characteristics, intervention details, instruments used, and main findings. This structured approach ensured consistency and reliability in data collection.

Data Item
The extracted data items included: (1) study characteristics (author, year, country); (2) participant details (sample size, educational level); (3) intervention characteristics (type and duration of CSI); (4) outcome measures (cognitive processing indicators and reading comprehension performance); and (5) key findings related to the effectivene ss of the intervention.

Study Risk of Bias Assessment
The risk of bias in individual studies was assessed using established quality appraisal criteria, including clarity of research design, validity and reliability of instruments, and appropriateness of data analysis techniques. Studies were categorized into low, moderate, or high risk of bias to ensure critical evaluation of evidence quality.

Effect Measures
For quantitative studies, effect sizes (e.g., Cohen’s d, mean differences) were considered where available to evaluate the magnitude of CSI effectiveness. For qualitative studies, thematic findings related to cognitive processing and reading comprehension were analyzed to complement quantitative evidence (Kim et al., 2006).

Synthesis Methods
A narrative synthesis approach was employed due to heterogeneity in study designs, interventions, and outcome measures. The synthesis focused on identifying patterns, similarities, and differences across studies, particularly in terms of instructional effectiveness and influencing factors. Findings were grouped thematically to provide a comprehensive interpretation of the data.

Reporting Bias Assessmen
Potential reporting bias was assessed by examining publication trends, selective outcome reporting, and the availability of full-text articles. The inclusion of multiple databases and comprehensive search strategies helped minimize the risk of publication bias (Page et al., 2021)
Certainty Assessment.

Analysis

The study selection process followed the PRISMA 2020 guidelines, resulting in a transparent and systematic identification of relevant studies. A total of 245 records were initially identified through database searches across Scopus, Web of Science, ERIC, and Google Scholar. After removing 57 duplicates, 188 records remained for title and abstract screening. Of these, 142 studies were excluded due to irrelevance to Cognitive Strategy Instruction (CSI) or reading comprehension. The full texts of 46 articles were then assessed for eligibility, resulting in the exclusion of 28 studies due to methodological limitations or lack of relevant outcome measures. Ultimately, 18 studies met all inclusion criteria and were included in the final synthesis.

The included studies were conducted across diverse educational contexts, including primary, secondary, and tertiary levels, with sample sizes ranging from small classroom-based interventions to large-scale quasi-experimental studies. Most studies employed quantitative designs, particularly experimental and quasi-experimental approaches, while several utilized mixed-methods designs to capture both statistical outcomes and qualitative insights. The duration of interventions varied from short-term (4–6 weeks) to longer instructional programs (up to one semester). Across studies, Cognitive Strategy Instruction commonly involved strategies such as predicting, questioning, summarizing, and monitoring comprehension.

Regarding the risk of bias, the majority of studies were assessed as having moderate risk due to limitations in sample size, lack of randomization, or insufficient reporting of validity and reliability measures. However, several studies demonstrated low risk of bias, particularly those employing rigorous experimental designs and validated instruments. Overall, the methodological quality of the included studies was considered acceptable for synthesis, although variability across studies should be noted. The results of individual studies consistently indicated that Cognitive Strategy Instruction had a positive effect on both cognitive processing and reading comprehension. Specifically, students exposed to CSI demonstrated improved metacognitive awareness, enhanced inferential reasoning, and better integration of textual information. In terms of narrative reading comprehension, learners showed significant gains in identifying story structure, understanding main ideas, and interpreting implicit meanings.

The synthesis of results revealed several key patterns. First, CSI was most effective when implemented through explicit and scaffolded instruction, allowing learners to gradually internalize strategies. Second, the effectiveness of CSI was influenced by learners' proficiency levels, with lower-performing students benefiting more substantially from structured strategy instruction. Third, longer intervention durations tended to produce more sustained improvements in both cognitive processing and reading comprehension outcomes.

Findings and Discussion

In terms of reporting biases, the review identified a potential risk of publication bias, as studies reporting positive outcomes were more likely to be published. Additionally, limited reporting of null or negative findings may have influenced the overall interpretation of effectiveness. However, the use of multiple databases and comprehensive search strategies helped mitigate this risk

Pig.1Table PRISMA Guidellines

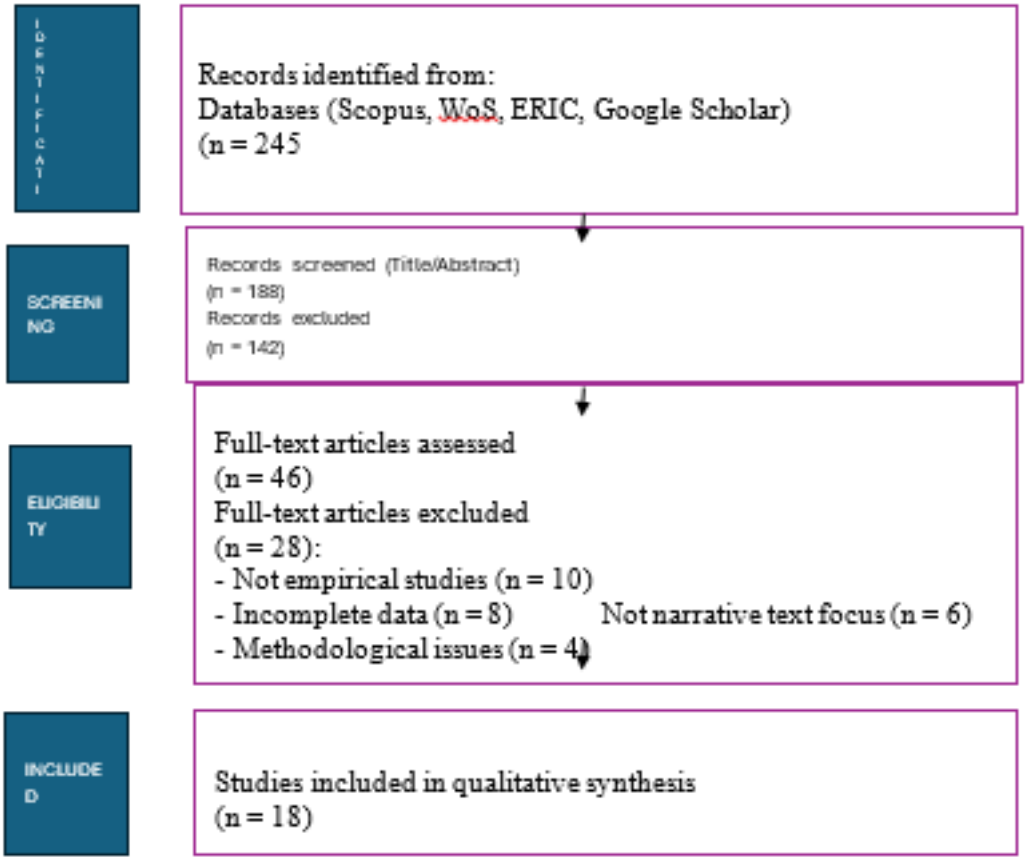

Table 1SLR Article Summary

No	Author(s) & Year	Title	Study Type	Key Findings
1	(Maeng, 2014).	The effectiveness of reading strategy instruction: A meta-analysis. English	present meta-analysis:	strategy instruction, reading strategies, reading comprehension, meta-analysis
2	(Sun et al., 2021),	The Relationship Between Reading Strategy and Reading Comprehension: A Meta-Analysis	present meta-analysis:	Lower-proficiency learners show greater improvement with structured CSI
3	(Tawarik et al., 2021)	Effect of CALLA metacognitive strategy instruction on reading	Quasi-experimental	CALLA, MSI, reading comprehension, reading awareness

		comprehension and reading awareness		
4	(Shaimaa Hamdy Abd El-Azeem Abd El-attah et al., n.d.)	Utilizing Inferencing Strategy for Developing EFL Reading Comprehension Skills Among Faculty of Education Students	Mixed-methods	Text Modification – Inferencing strategy – EFL reading comprehension skills
5	(Mehrdad et al., 2012)	The effect of teaching cognitive and metacognitive strategies on EFL students' reading comprehension across proficiency levels	Experimental	Cognitive strategies, metacognitive strategies, proficiency level, EFL student
6	(Reza Ahmadi et al., 2013)	The Importance of Metacognitive Reading Strategy Awareness in Reading Comprehension	Experimental	metacognitive reading strategy, reading comprehension, EFL students, teaching metacognitive strategy
7	(Amini et al., 2020)	Modeling the relationship between metacognitive strategy awareness, self-regulation and reading proficiency of Iranian EFL learners	Meta-analysis	metacognitive strategy awareness; self-regulation; structural equation modeling (SEM); second language; reading proficiency
8	(Sun et al., 2021)	The Relationship Between Reading Strategy and Reading Comprehension: A Meta-Analysis	present meta-analysis:	Lower-proficiency learners show greater improvement with structured CSI
9	(Mehrdad et al., 2012)	The effect of teaching cognitive and metacognitive strategies on EFL students' reading comprehension across proficiency levels	Experimental	Cognitive strategies, metacognitive strategies, proficiency level, EFL student
10	(Maeng, 2014)	The Effectiveness of Reading Strategy Instruction: A Meta-Analysis	present meta-analysis:	strategy instruction, reading strategies, reading comprehension, meta-analysis
11	(Sun et al., 2021))	The Relationship Between Reading Strategy and Reading Comprehension: A Meta-Analysis	present meta-analysis:	Lower-proficiency learners show greater improvement with structured CSI
12	(Khurram, 2023)	The Impact of Metacognitive Instruction on ESL University Level Students' Awareness and Use of the Reading Strategies	Action research	Keywordsmetacognitive reading strategies instruction, metacognitive awareness, strategy use, action research, tertiary, Pakistan
13	(Arrington et al., 2014)	The Contribution of Attentional Control and Working Memory to Reading	Experimental	*he Contribution of Attentional Control and Working Memory to Reading*

		Comprehension and Decoding		*Comprehension and Decoding"*
14	(Kavani & Amjadiparvar, 2018a)	The effect of strategy-based instruction on motivation, self-regulated learning, and reading comprehension ability of Iranian EFL learning	quasi-experimental research	Strategy-based instruction; motivation; self-regulated learning; reading comprehension
15	(Kavani & Amjadiparvar, 2018b)	The effect of strategy-based instruction on motivation, self-regulated learning, and reading comprehension ability of Iranian EFL learning	quasi-experimental research	Strategy-based instruction; motivation; self-regulated learning; reading comprehension
16	(Mirzahoseini et al., 2015)	A Contrastive Analysis of Adjuncts Regarding Their Manner of Expression in English and Persian	Contrastive Analysis	SFG, Manner of Expressing, Interpersonal, Experiential, Textual, Adjunct.
17	(Mehrdad et al., 2012)	The effect of teaching cognitive and metacognitive strategies on EFL students' reading comprehension across proficiency levels	Experimental	Cognitive strategies, metacognitive strategies, proficiency level, EFL student
18	(Ali & Razali, 2019)	A Review of Studies on Cognitive and Metacognitive Reading Strategies in Teaching Reading Comprehension for ESL/EFL Learners:	Analysis	reading comprehension, cognitive reading strategies, metacognitive reading strategies, English as a second language (ESL), English as a Foreign Language (EFL)

The synthesis of the 18 selected studies demonstrates that Cognitive Strategy Instruction (CSI) significantly enhances both cognitive processing and reading comprehension, particularly in narrative texts. Learners who receive explicit and structured strategy instruction show notable improvements in higher-order cognitive skills, including inferencing, summarizing, and integrating textual.

A key finding across the reviewed studies is the important role of metacognitive awareness in supporting the effectiveness of CSI. Students who are trained in cognitive strategies develop stronger abilities to plan, monitor, and evaluate their understanding In addition, self-regulated reading practices further enhance comprehension outcomes, as learners become more reflective and autonomous in managing their reading processes. In the context of narrative texts, CSI is particularly effective due to the complexity of narrative structures. Learners are required to understand elements such as plot, characters, and implicit meanings. Evidence shows that CSI helps students identify key story components and construct deeper interpretations of texts, nother important aspect highlighted in the review is the variation in CSI effectiveness across learner proficiency levels. Lower-proficiency learners tend to benefit more from explicit and scaffolded instruction because it provides structured guidance that supports their limited cognitive resources (Kim et al., 2006).

Despite these positive findings, several limitations are identified across the reviewed studies. There is considerable variation in research design, sample characteristics, and measurement tools, which may affect the comparability of results (Page et al., 2021). Overall, this review provides a comprehensive synthesis of the role of CSI in enhancing cognitive processing and narrative reading comprehension. The findings highlight the importance of integrating cognitive, metacognitive, and affective dimensions in reading instruction. From a pedagogical perspective, educators are encouraged to implement CSI through explicit teaching, scaffolding, and guided practice while adapting instruction to learners' needs and proficiency levels.

Conclusion

This systematic literature review confirms that Cognitive Strategy Instruction (CSI) is effective in improving students' cognitive processing and narrative reading comprehension. Based on 18 selected studies, CSI consistently enhances inferencing, metacognitive awareness, and understanding of narrative texts. The findings also show that explicit and structured instruction produces better learning outcomes, especially for lower-proficiency learners. Despite some methodological limitations across studies, CSI remains a valuable instructional approach for improving reading comprehension in language learning context.

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Exploring the Impact of Self-Directed Learning Approaches on Academic Achievement from the Perspective of University Educators in Libya

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Abstract

The purpose of this study is to investigate the impact of SDL on the academic performance of college students in higher education institutions from the viewpoint of lecturers in universities, particularly the Libyan educational system. The methodology employed for this research is a systematic literature review (SLR) based on PRISMA 2020 standards, which involves systematic identification, screening, eligibility, and inclusion of articles. Data collection was conducted from six reliable scientific sources, namely Scopus, Web of Science, ScienceDirect, ERIC, PubMed, and Google Scholar, for publications from 2021 to 2026. A total of 20 scientific articles were selected for analysis through thematic synthesis techniques. The findings suggest that SDL significantly impacts the academic performance of students in higher education positively and consistently. It enhances self-regulation, motivation, self-efficacy, time management skills, and engagement in academic activities. Besides, the effectiveness of SDL can be affected by psychological aspects like motivation and self-efficacy and environmental aspects of learning, such as lecturer support and digital learning technology. Additionally, the results suggest that SDL is more successful when used in adaptive and technology-enhanced learning approaches such as online learning and AI-powered learning. Self-directed learning contributes significantly to enhancing the quality of learning in higher education through promoting independent learning and academic success. The research provides theoretical insights into developing a theory of self-regulated learning while offering practical insights into developing self-regulated learning approaches among lecturers and educational policymakers.

Keywords: Academic Achievement, Higher Education, PRISMA, Self-Directed Learning, Systematic Review

Introduction

The current educational paradigm in the world has experienced remarkable changes as a result of technological changes and new developments in pedagogy. This means that there has been a move away from traditional forms of learning towards learner-based forms of learning characterized by high levels of engagement, self-regulation, and reflection (Shen, 2008). Self-directed learning (SDL) represents one of such methods used under the umbrella of learner-centred approaches. Under SDL, learners play an active part in determining their learning needs, establishing their own learning goals, selecting learning materials, and reflecting on their achievements (Knowles, 1975). The theoretical framework for SDL revolves around the core principles of humanistic education based on

learners' autonomy and self-responsibility (Rogers, 1983; Dewey, 1916; Freire, 1998). The growing recognition of SDL has been prompted by its benefits for enhancing motivation, critical thinking and lifelong learning and also its positive influence on academic performance in disciplines such as English language learning (Song & Hill, 2007; Loyens et al., 2008; Cazan & Schiopca, 2014; Lee et al., 2014). Despite all of these benefits, the actual use of this technique remains limited within a number of developing countries, wherein higher education still uses traditional methods of learning based on memorization and thus does not promote development of learners' independence and critical thinking abilities (UNESCO, 2022; Al-Abbar, 2011).

Moreover, there are several barriers to education reform in Libya such as lack of institutional support, weak infrastructure and insufficient development of the trainers (Abu Shadid & Al-Habal, 2014), which have hindered application of the learner-centered approach within higher education. Taking into account crucial importance of trainers in the formation of SDL-positive environment (Pontis et al., 2020), it is essential to evaluate their perspective in this regard. However, the literature review revealed that there are few studies concerning this matter in relation to the situation in Libya (Jha, 2015). Therefore, this paper aims at analyzing the opinions of university trainers about self-directed learning, its effects on academic achievement, role of trainers in SDL promotion, and potential obstacles.

Review of Related Literature

Previous studies consistently demonstrate that self-directed learning (SDL) significantly improves students' academic achievement. Siswanto (2024) found that students in the SDL-based learning group achieved higher post-test scores, showing greater independence in setting goals, managing strategies, and evaluating progress. Similarly, Yang et al. (2025) reported that integrating SDL within structured frameworks enhances both self-efficacy and academic performance. Research by Eluemuno et al. (2025) further highlights SDL's strong positive influence in digital learning environments, where students adapt more effectively. Finn et al. (2024) emphasized that SDL effectiveness depends on curriculum design, institutional support, and learning environments. Moreover, studies reveal that SDL readiness, self-management, and autonomy contribute significantly to academic success (Mbeau-ache et al., 2021; Kim & Park, 2024). Strategies such as self-testing, reflection, and goal setting, supported by AI-based systems, further enhance learning outcomes and engagement

Objectives

This paper is derived from the theoretical phase of an ongoing PhD research project entitled: **"Exploring the Impact of Self-Directed Learning Approaches on Academic Achievement from the Perspective of University Educators in Libya**". The systematic literature review presented here constitutes the foundational framework for the subsequent empirical phase of the doctoral study, which is still in progress.

Methodology

The approach used in this research was the systematic literature review, following the PRISMA 2020 guidelines for conducting systematic reviews and meta-analyses. This approach was applied to identify, analyze, and synthesize previous scientific research studies related to the effect of SDL on student academic performance from the perspective

of university lecturers in Libya. The reason for selecting PRISMA 2020 is that it ensures high transparency in the process of selecting scientific research papers.

The sources of data used in this study were extracted from scholarly articles found in internationally recognized scientific journals, which were gathered from several databases, such as Scopus, Web of Science, ScienceDirect, ERIC (Education Resources Information Center), PubMed, and Google Scholar. Only articles published between 2019 and 2026 were considered to guarantee that the articles chosen were fresh and recent and could be applicable to the existing research trends in higher education. The search method for gathering relevant literature was conducted using several keywords including "self-directed learning," "independent learning," "student achievement," "academic performance," "higher education," "university lecturers' perception," and "Libya education system." In addition, Boolean operators were used to conduct the search process. For instance, the search process involved ("self-directed learning" OR "independent learning") AND ("student achievement" OR "academic performance") AND ("higher education" OR "university lecturers").

Reputable journal articles that were indexed by Scopus or Web of Science within 2020 and 2026 were selected as inclusion criteria for this research project. They should be dealing with self-directed learning at university or other educational institutions and include data on students' academic performance or achievement. It is important to note that the sources used might be of qualitative, quantitative, or mixed method in terms of their research type. On the contrary, exclusion criteria included the following elements: inaccessible sources of information (articles that are only abstracts or have no full text), sources that do not deal with SDL topic, sources about self-directed learning at primary and secondary educational institutions, duplicates, and sources of information that are non-scientific (such as opinion papers). Finally, thematic synthesis was selected as a data analysis technique, which involved grouping scientific data into several topics, including the impact of SDL on students' achievements, effective SDL, lecturers' role in promoting SDL, and others.

Validity and reliability of data were ensured by employing credible scientific databases, utilizing the PRISMA method for selecting literature, triangulating sources from different international journals, and repeating the search procedure to guarantee consistent results. In addition, the study employed the PRISMA 2020 flow chart for selection of literature, which comprises the processes of identification, screening, eligibility, and inclusion of research sources.

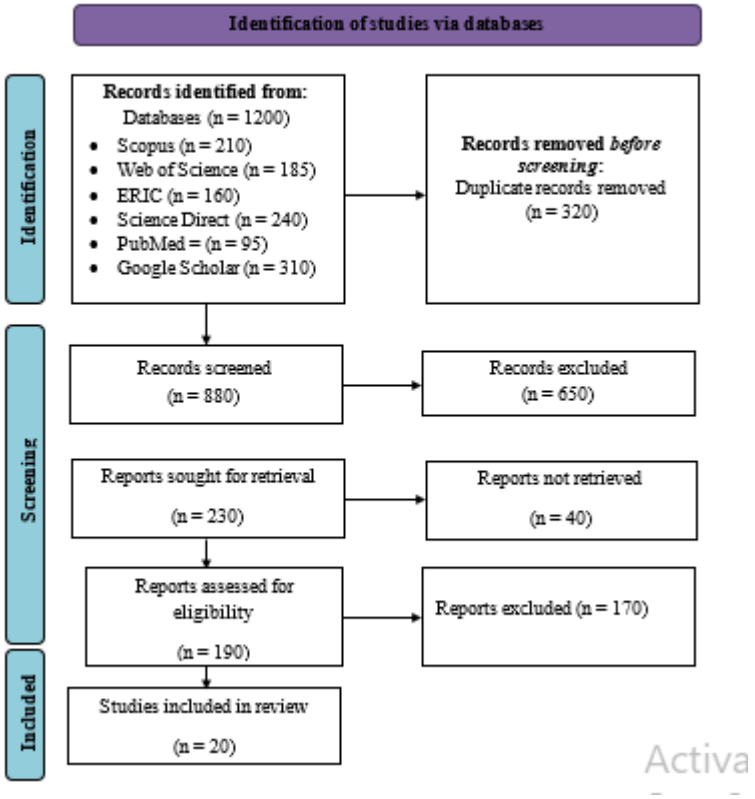

Figure 1. PRISMA

Analysis

Based on the selection results using the PRISMA 2020 method, 20 scientific articles met the inclusion criteria. These articles were analyzed using a thematic synthesis approach to identify key patterns related to the influence of Self-Directed Learning (SDL) on student achievement in higher education.

No	Author	Research Design	Research Result
1	Siswanto (2024)	Experimental	SDL significantly improves students' academic achievement by increasing learning independence, goal-setting ability, and self-regulated learning behavior. Students in the experimental group showed higher post-test scores compared to the control group.
2	Yang et al. (2025)	Quasi-experimental	The integration of SDL within the BOPPPS teaching model significantly enhances students' self-efficacy and academic achievement. Students demonstrated improved learning engagement and higher test performance after intervention.

3	Eluemuno et al. (2025)	Survey	SDL positively influences academic performance in digital learning environments. Students with higher SDL levels showed better adaptability to online learning and higher academic achievement scores.
4	Finn et al. (2024)	Scoping review	SDL effectiveness is influenced by curriculum structure, instructor support, and learning environment. SDL improves clinical reasoning and academic performance in health education contexts.
5	Mbeau-ache et al. (2021)	Quantitative	SDL readiness is positively correlated with academic achievement. Students with higher readiness levels perform better in structured academic tasks and independent learning activities.
6	Zhao et al. (2023)	Quantitative	Self-management skills and SDL significantly improve academic achievement through better time management, planning, and cognitive regulation.
7	Sánchez-Élez et al. (2024)	Experimental	SDL-based self-testing strategies significantly improve retention, understanding, and academic performance compared to traditional learning methods.
8	Mao (2025)	Conceptual	AI-supported SDL enhances personalized learning, adaptive feedback, and student autonomy, which ultimately improves learning effectiveness and academic performance.
9	Zhang et al. (2023)	Quantitative	SDL has a significant positive effect on GPA. Students with higher SDL show better academic consistency and higher final grades.
10	Kim & Park (2024)	Quantitative	Learning autonomy significantly predicts academic success. SDL increases students' responsibility for learning and improves achievement outcomes.
11	Lopez et al. (2023)	Mixed methods	SDL strategies (goal setting, self-monitoring, reflection) significantly improve student learning outcomes and engagement in higher education.
12	Rahman et al. (2023)	Quantitative	SDL has a strong positive relationship with academic success. Students with higher SDL demonstrate better problem-solving and academic performance.
13	Nguyen et al. (2023)	Quantitative	SDL is more effective in digital learning environments, where flexibility and access to resources enhance student performance.

14	Johnson et al. (2022)	Quantitative	SDL readiness significantly influences academic performance. Students with higher readiness are more successful in independent learning tasks.
15	Lee et al. (2022)	Quantitative	Learning motivation strengthens SDL behavior, leading to improved academic achievement and sustained learning engagement.
16	Hidayat et al. (2022)	Quantitative	SDL significantly improves student learning outcomes in Indonesian higher education institutions through increased autonomy and discipline.
17	Garcia et al. (2022)	Experimental	SDL-based instructional models significantly improve student achievement compared to conventional teaching methods.
18	Chen & Huang (2022)	Quantitative	Self-efficacy mediates the relationship between SDL and academic achievement, strengthening students' learning confidence and performance.
19	Thompson et al. (2021)	Review	SDL improves critical thinking skills, academic engagement, and overall student achievement in higher education settings.
20	Sari et al. (2022)	Quantitative	SDL increases academic engagement, which directly contributes to improved academic achievement and classroom participation.

The findings from the selected studies indicate that Self-Directed Learning (SDL) consistently exerts a positive influence on student academic achievement in higher education. Across the 20 reviewed articles, SDL is shown to enhance students' ability to regulate their own learning processes, improve academic performance, and strengthen engagement in learning activities.

Findings and Discussion

The experimental study conducted by Siswanto (2024) revealed that SDL significantly improves students' academic achievement. The results demonstrated that students in the SDL-based learning group achieved higher post-test scores compared to those in the control group. This finding indicates that SDL fosters students' independence in learning, particularly in setting learning goals, managing learning strategies, and evaluating their academic progress. Similarly, Yang et al. (2025) found that integrating SDL within the BOPPPS instructional model significantly enhances both self-efficacy and academic achievement. These findings suggest that SDL is more effective when embedded within structured pedagogical frameworks, as this combination enables students to actively construct knowledge while still receiving appropriate instructional guidance. Furthermore, the study by Eluemuno et al. (2025) highlighted that SDL has a strong positive influence on academic performance in digital learning environments. Students with higher SDL abilities tend to adapt more effectively to online learning systems, which

subsequently leads to improved academic outcomes. This emphasizes the increasing relevance of SDL in contemporary digital education contexts.

In addition, the scoping review conducted by Finn et al. (2024) explained that the effectiveness of SDL is influenced by curriculum design, institutional support, and the learning environment. The study emphasizes that SDL does not solely depend on individual student capability, but also on the extent to which the educational system facilitates independent learning. This finding underscores the importance of a supportive academic ecosystem for successful SDL implementation. The correlational study by Mbeau-ache et al. (2021) found that SDL readiness is significantly associated with academic achievement. Students with higher readiness for self-directed learning tend to perform better academically. This suggests that factors such as discipline, responsibility, and time management play a crucial role in determining SDL effectiveness.

Moreover, Zhao et al. (2024) demonstrated that self-management skills significantly contribute to academic success. SDL enhances students' ability to manage time effectively, organize learning tasks, and regulate cognitive processes, all of which directly improve academic performance and learning efficiency. The experimental study by Sánchez-Élez et al. (2024) showed that self-generated learning strategies, such as self-testing and reflection, significantly improve knowledge retention and academic performance. This finding confirms that SDL promotes active learning processes that contribute to long-term academic achievement.

In addition, Mao (2025) highlighted the role of artificial intelligence in supporting SDL. AI-based learning systems provide adaptive feedback and personalized learning pathways, which further enhance students' autonomy and academic performance. This indicates that technological innovation is becoming an increasingly important factor in strengthening SDL effectiveness. The quantitative study by Zhang et al. (2023) confirmed that SDL has a significant positive effect on GPA. Students with higher SDL tendencies demonstrate greater consistency in academic performance and achieve higher overall academic results, reinforcing the direct relationship between SDL and academic success. Furthermore, Kim and Park (2024) found that learning autonomy significantly predicts academic success. SDL increases students' responsibility for their own learning processes, which ultimately leads to improved academic outcomes. This finding highlight autonomy as a core component of SDL effectiveness. The study by Lopez et al. (2023) indicated that SDL strategies such as goal setting, self-monitoring, and reflection significantly improve learning outcomes and student engagement. These strategies enable students to become more aware of their learning processes, thereby enhancing academic performance.

Similarly, Rahman et al. (2023) confirmed that SDL has a strong positive relationship with academic success, particularly in improving problem-solving abilities and critical thinking skills among students. In the context of digital learning, Nguyen et al. (2023) found that SDL is more effective in online learning environments, where students have greater flexibility in accessing learning materials and managing their study time independently. The study by Johnson et al. (2022) emphasized that SDL readiness significantly influences academic achievement. Students with higher levels of readiness are more successful in completing independent learning tasks and academic assessments. Additionally, Lee et al. (2022) demonstrated that learning motivation strengthens SDL behaviour, which subsequently leads to improved academic achievement. Motivated

students are more consistent in applying SDL strategies throughout their learning process. The Indonesian study conducted by Hidayat et al. (2022) found that SDL significantly improves learning outcomes in higher education institutions by fostering discipline and academic responsibility among students.

The experimental study by Garcia et al. (2022) also confirmed that SDL-based instructional models are more effective than conventional teaching methods in improving student academic performance. Furthermore, Chen and Huang (2022) demonstrated that self-efficacy acts as a mediating factor in the relationship between SDL and academic achievement. Students with higher self-efficacy are more confident in applying SDL strategies, which leads to better academic outcomes. The systematic review by Thompson et al. (2021) concluded that SDL enhances critical thinking skills and academic engagement, both of which contribute significantly to improved student achievement. Finally, Sari et al. (2021) found that SDL increases academic engagement, which directly influences student performance in higher education settings.

As a part of an ongoing PhD research project, and in light of the current SLR undertaken under the PRISMA 2020 methodology, which has analysed 20 articles written between 2021 and 2025, the following conclusions can be drawn regarding the effect of SDL on student academic performance within the context of higher education. In particular, the results of thematic synthesis prove that students with a higher degree of SDL competence perform more efficiently in academic terms, have a higher level of learning autonomy and exhibit better self-regulatory skills in the process of learning. At the same time, it should be noted that the efficiency of SDL is dependent upon multiple interconnected factors, including psychological factors such as self-efficacy and motivation, behavioural factors such as engagement with the learning process, and situational factors related to digitalized learning.

In regards to the contributions that this research makes in theory, the study builds on the knowledge base of SDL through the inclusion of evidence from new research and further cementing the principles of Andragogy Theory and Constructivist Learning Theory. In addition, the study makes significant contributions to a more in-depth understanding of SDL by highlighting four influential factors, which include direct academic influence, psychological influence, learning influence, and digital learning environment. In terms of practical implications, the research has significant implications for universities, lecturers, students, and policymakers. Universities are advised to incorporate SDL-based learning approaches in their curricula, lecturers must be facilitators in the learning process, students are required to master self-regulated learning abilities, and policymakers need to enhance digital learning environments.

Conclusion

However, there are some limitations associated with this research paper. Firstly, the literature review will be conducted based on 20 articles that have been selected randomly. It is uncertain whether these selected articles will cover all aspects of SDL in the world. Secondly, the study will be confined to articles published between 2021 and 2025. Therefore, there is a possibility that some important articles published before the stipulated time frame will be overlooked. Thirdly, there might be differences in research methods applied in different articles, which could limit comparability during the synthesis phase.

Considering these constraints, further studies are recommended to include larger databases as well as greater periods of publications. Moreover, future studies are encouraged to use quantitative meta-analytic approaches to quantify the impact size of SDL. Future research may be conducted to investigate SDL within emerging areas such as AI-supported environments, hybrid learning systems, and cross-cultural education. Empirical investigations within such domains will add to our knowledge of SDL in higher education.

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E-Content Led to Sustainable Development for the Process of Teaching and Learning

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Abstract

E-content is one of the ways of Digitization and even modernization. ICT procedure is proposed for effective teaching and learning process to handle different subjects. The different E-sources were changing the way of communication technology with making of videos various tools used for effective teaching learning method. ICT is a combination of digital with social media into a presentation to convey a message to students. This study represents issue on sustainable developing an innovative and user-friendly e-content generation to adoption procedure suitable for different aspects of electronic content. The study is to find out usage of E-Content tools by teaching and learning in higher education and their view on strength and weakness. Three colleges and 30 teachers of Madurai region have been chosen through random sampling technique to form the sample. The content and its quality is the key component of education system. The e-content are divided into different tools and techniques. The modules include AI tools PPT and Screen-Casto-Matic, animation video and relevant YouTube videos, virtual tour with Thing link, Audio and visual lectures. The study found that ICT services have improved historical studies by facilitating access to information, analysis of data, and dissemination of research findings. The study recommends the need for proper training of students and lecturers on the use of ICT and E-content in the sustainable process.

Keywords: Audio and Video, AI tools, Digitization, ICT, Sustainable

Introduction

Information and Communication Technology (ICT) in education is the mode of education that uses information and communications technology to support, enhance, and optimize the delivery of information (Maria Jose,2012) Worldwide research has shown that E-Content can lead to an improved student learning and better teaching methods (Chris Abbot, 2000). A report made by the National Institute of Multimedia Education in Japan, proved that an increase in the use of ICT in education with integrating technology to the curriculum has a significant and positive impact on students' achievements (Kathryne, Tchombe 2001). The objective of the study is to analyse the necessity of adoption of ICT tools to access historical studies, to analyse the benefits of using ICT tools in historical studies, to study the professional bonding between learners and instructors. The results specifically showed that the students who are continuously exposed to technology through education has better 'knowledge', presentation skills, innovative capabilities, and are ready to take more efforts into learning as compared to their counterparts.

Review of Related Literature

E-content has become an important component of sustainable development in the process of teaching and learning. With the rapid growth of information and communication technology, education has moved beyond traditional classroom boundaries and has become more flexible, interactive, and learner-centred. Abbott (2000) explains that ICT has changed the nature of education by influencing how knowledge is created, shared, and accessed. In this context, e-content supports sustainable education by reducing dependency on printed materials, improving access to learning resources, and enabling continuous learning across different locations.

Digital learning also promotes innovation in pedagogy. Veletsianos (1998) highlights the emergence of new forms of digital learning, where technology creates opportunities for collaboration, creativity, and knowledge construction. E-content allows teachers to present information through text, audio, video, animation, simulations, and interactive activities. These formats help students understand complex concepts more effectively and encourage active participation in the learning process. Similarly, Kathryne Tchombe (2001) emphasizes that ICT changes educational mind-sets by encouraging teachers and learners to adopt more open, flexible, and participatory approaches.

Maria Jose (2012) observes that ICT in education strengthens teaching-learning practices by supporting resource sharing, communication, assessment, and independent learning. Through e-content, students can learn at their own pace and revisit learning materials whenever necessary. This contributes to inclusive and sustainable education because learners with different abilities, locations, and learning styles can access the same educational resources. Neelamalar and Chitra (2009) further suggest that new media has transformed communication in society and education by making information more dynamic, interactive, and widely available.

UNESCO also emphasizes the role of ICT in improving education systems and preparing learners for a knowledge-based society. Online platforms such as Pedagoo demonstrate how ICT can support assessment, collaboration, personalization, and learner engagement. Similarly, Google Arts and Culture shows how digital resources can preserve and share cultural knowledge globally, making education more accessible and meaningful.

Overall, the literature shows that e-content contributes to sustainable development in teaching and learning by improving accessibility, reducing resource consumption, encouraging lifelong learning, and supporting innovative pedagogy. Therefore, effective use of e-content can make education more inclusive, flexible, and sustainable.

Objectives

The main objective of this study is to examine the role of ICT and e-content in improving the process of teaching and learning. The study aims to analyse the necessity of adopting ICT tools for accessing and understanding historical studies. It seeks to identify how digital resources and e-content can support students in gaining better knowledge and conceptual clarity. Another objective is to examine the benefits of using ICT tools in historical studies, particularly in terms of accessibility, engagement, presentation skills, and innovative learning. The study also aims to understand how ICT-based teaching can strengthen the professional relationship between learners and instructors. It further seeks to explore how technology-supported learning encourages students to participate more

actively in the educational process. The study intends to assess whether continuous exposure to technology improves students' learning motivation, creativity, and academic performance. Finally, the study aims to highlight the importance of ICT and e-content as sustainable tools for modern, flexible, and effective education.

Methodology

This research is based on both descriptive and analytical research designs. Descriptive research provides an accurate account of individuals, situations, and phenomena, while analytical research helps interpret and evaluate the collected data in a systematic manner. The research design facilitated an in-depth understanding of the views and experiences of lecturers and students regarding the impact of e-content adoption on historical research and learning.

Questionnaires were used to collect quantitative data from students and lecturers, while interviews, observations, and discussions may also support the collection of qualitative insights to obtain a broader understanding of the subject. MS Excel and Google Forms were used to organize, tabulate, and analyze quantitative data efficiently, and the findings were presented through tables, charts, and graphical representations for clarity and better interpretation. Secondary data were collected from journals, books, research articles, conference proceedings, online databases, and academic websites related to the use of e-content and ICT in education.

The prime objective of this study is to analyze the necessity of adopting ICT tools in historical studies, to explore the benefits of using ICT tools for sustainable research and effective learning, and to study the professional bonding and interaction between learners and instructors through digital platforms. The study also aims to examine how ICT tools improve students' engagement, motivation, participation, research skills, critical thinking, and academic performance in history education.

Furthermore, the research investigates the role of e-content in promoting student-centered learning, self-directed learning, collaborative learning, and flexible learning environments. It also examines the effectiveness of digital resources such as virtual tours, multimedia presentations, online archives, AI tools, digital libraries, and educational videos in enhancing historical understanding and interpretation. The study highlights how ICT integration supports sustainable development in education by encouraging innovation, inclusiveness, accessibility, and lifelong learning opportunities. It also evaluates the challenges faced in adopting e-content, such as lack of infrastructure, limited technological skills, inadequate internet connectivity, financial constraints, and insufficient teacher training. Data were analyzed thematically based on the theory of constructive alignment, emphasizing the relationship between learning objectives, teaching methods, assessment strategies, and e-content development. The study demonstrates that properly designed e-content contributes to sustainable development by improving the effectiveness of teaching and learning processes, fostering meaningful learning experiences, and preparing learners for the demands of the digital age. The research emphasizes that ICT-enabled education strengthens communication and collaboration between teachers and students, enhances academic networking, and bridges the gap between theoretical knowledge and practical application. The findings also suggest that continuous ICT training, curriculum revision, and institutional support are essential for maximizing the benefits of e-content in historical research and education.

Findings and Discussion

Key findings of the study are summarized in table 01, as major roles of

Table 01: Major Roles of E-Content towards Sustainable Process of Learning and Teaching

Themes	Role of E-Content towards Sustainable process of learning and teaching
In Defining Learning Outcomes	Providing computer knowledge, to learn digital documenting technique. and knowledge for defining more relevant learning outcomes.
In Teaching-Learning Activities	Engaging in the process of Curriculum Design and Development through collaborative creation of E-content to impart tutor/teacher/professor they can work without the generation gap based on this ICT. Offering students and academic staff should be regularly sensitized on the latest ICT innovations adopted by the University and Colleges. Internships and Work Placements to enable practical application of theoretical knowledge through hands-on experiences. Delivering guest Lectures and through customized ICT training workshops for both academician and learners. Regular sensitization programs for students and academic staff on emerging ICT innovations adopted by universities and colleges help create awareness about modern educational technologies, artificial intelligence tools, virtual learning environments, cloud computing, and digital research platforms. Continuous ICT training improves confidence, technological adaptability, and professional competence among educators and learners, enabling them to effectively participate in digital learning environments. Internships and work placements provide opportunities for experiential learning and practical application of theoretical concepts. They help students gain workplace exposure, professional ethics, communication skills, teamwork abilities, and technical competencies required in modern careers. ICT-supported internships also familiarize students with industry-standard software, online collaboration tools, and digital workplace practices, enhancing their employability and career readiness. Delivering guest lectures, webinars, online seminars, and customized ICT workshops allows learners and academicians to interact with experts, industry professionals, and researchers from different fields, broadening their academic and professional perspectives. ICT workshops promote lifelong learning, self-improvement, and continuous professional development by helping participants stay updated with current technological trends and innovative teaching-learning methods.

	The use of advanced ICT tools in education supports flexible, blended, and distance learning opportunities, ensuring accessibility and inclusiveness for learners from diverse backgrounds and geographical locations. ICT integration also strengthens research activities by providing access to digital libraries, online journals, academic databases, plagiarism detection tools, and collaborative research networks. Technology-enhanced learning environments encourage critical thinking, creativity, innovation, analytical reasoning, and problem-solving skills, which are essential for academic excellence and future professional success. Furthermore, ICT facilitates effective communication and collaboration among institutions, teachers, students, and researchers at local, national, and international levels, thereby improving the overall quality and global relevance of education.
In Student Assessment	Participate in formulating assessment tasks aimed at validating skills and evaluating practical competencies through E-Content should be integrated in all research, teaching and learning activities offered for students and faculties. E-content-based assessment methods such as online quizzes, digital assignments, virtual presentations, simulations, project-based tasks, and interactive activities encourage active participation and practical application of knowledge. These approaches support competency-based education by assessing not only theoretical understanding but also problem-solving abilities, creativity, collaboration, communication, and technical skills. Moreover, technology-enabled teaching and assessment create opportunities for personalized learning, immediate feedback, peer learning, and reflective learning practices. It also strengthens institutional efficiency by reducing paper-based work, supporting eco-friendly practices, and improving academic administration. Therefore, the proper integration of e-content and advanced ICT tools in teaching, learning, research, and assessment activities is essential for developing skilled, competent, and future-ready learners and educators.
In General (Other)	Providing the E-content assist the students in accessing digital information efficiently and effectively. It Support student-centered and provide self-directed learning. Partnering on research initiatives that bridge the gap between academic exploration and real-world implementation. Supporting student-centered and provide self-directed learning Advocating for the promotion of collaborative learning in a distance-learning environment, more opportunities to develop critical (higher-order) thinking skills. In addition, e-content and digital learning tools increase student motivation, engagement, and participation by using multimedia elements such as videos, animations, simulations, quizzes, and interactive presentations. They support personalized learning experiences, helping

	students with different learning styles and abilities. ICT tools also improve communication between teachers and students, facilitate instant feedback and assessment, and encourage active participation in the learning process. Furthermore, digital learning resources help students gain global exposure by connecting them with diverse cultures, perspectives, and educational content from around the world. Virtual tours, online archives, and digital museums make learning more realistic and experiential, especially in subjects like history and social sciences. ICT integration also prepares students for the modern technological world by developing skills such as communication, collaboration, creativity, adaptability, and technological competence, which are essential for higher education and future careers.

Source: Author construct based on the literature findings

Conclusion

Based on ICT tools such as E content videos, AI tools, virtual tours, and PowerPoint presentations. Office automation skill-embedded paper is also included in the curriculum, but the curriculum needs further enhancement with the proper inclusion of advanced ICT tools. In conclusion, ICT enhanced historical studies can provide students with a more comprehensive and engaging learning experience, facilitating the development of critical thinking skills and the ability to analyze and interpret data. It also helps to foster a greater appreciation of cultural diversity and global perspectives, bridging the gap between the classroom and the real world, promoting collaboration and communication among students and teachers, creating a more interactive and engaging learning environment, and developing a deeper understanding of the past and its relevance and impact on the present. In addition, ICT tools support personalized and self-paced learning, enabling students to access educational resources anytime and anywhere. Digital archives, online museums, and historical databases provide authentic sources that enrich research skills and independent learning. The use of multimedia elements such as animations, simulations, and interactive timelines helps simplify complex historical concepts and improves long-term retention of knowledge. ICT also prepares students for the digital age by developing technological competence, creativity, problem-solving abilities, and information literacy. Moreover, online platforms encourage inclusive education by supporting diverse learning styles and making learning materials accessible to differently abled learners.

Teachers also benefit from ICT integration through better lesson planning, innovative teaching strategies, easy assessment methods, and efficient classroom management. The use of advanced technologies can increase student motivation and curiosity, making history more meaningful and enjoyable. However, despite these advantages, challenges such as lack of infrastructure, limited internet access, insufficient teacher training, and unequal availability of digital resources still exist. Therefore, the curriculum requires further enhancement through the proper inclusion of advanced ICT tools, regular teacher training programs, updated digital content, and improved technological infrastructure to ensure effective and inclusive historical education for future generations.

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Foreign Language Instruction for History Students through the Lens of Bloom's Taxonomy

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Abstract

This article examines how Bloom's Taxonomy can guide foreign language instruction for history students, emphasizing a structured progression from lower- to higher-order cognitive processes within discipline-specific tasks. Drawing on research in EFL, ESP, humanities instruction, and history-focused courses, it develops a taxonomy-based conceptual framework that integrates Bloom's six cognitive levels with language skills (reading, writing, listening, speaking) and historical competencies, including factual comprehension, source interpretation, analysis, evaluation, and synthesis. To illustrate the framework's pedagogical coherence, one representative topic — "Appearance and Character: The Character Traits of Leaders of History" (grammar focus: adjectives)—demonstrates how each cognitive level can be operationalized through reading, writing, speaking, and listening tasks, linking linguistic development with historical reasoning. Evidence from the literature and the illustrative example suggests that taxonomy-informed instructional design enhances vocabulary acquisition, grammatical accuracy, engagement, and higher-order cognitive skills, while many existing courses remain limited to low-level recall. The article proposes a flexible and theoretically grounded instructional model for curriculum planning, task sequencing, and assessment in history-oriented foreign language instruction, providing implications for promoting integrated language and disciplinary learning.

Keywords: Bloom's Taxonomy, Conceptual Framework, Foreign Language Instruction, Higher-Order Thinking, History Students

Introduction

Sustainable Amid globalization and the increasing internationalization of tertiary education, foreign language proficiency has become an essential academic and professional requirement for university students across disciplines. For students majoring in history, foreign language competence is particularly significant, as it enables access to primary historical sources, international scholarly literature, and cross-cultural academic discourse. Despite this importance, foreign language instruction for history students is often limited to general linguistic objectives and does not sufficiently address the cognitive and disciplinary demands of historical studies.

Foreign language instruction for history students sits at the intersection of disciplinary thinking and academic language learning, yet most research on Bloom's Taxonomy in language education has treated learners as a general EFL/ESP population rather than as members of a specific content discipline. Integrative approaches such as CLIL and

history-based content-language models show that history can effectively serve as a vehicle for foreign language development, but they rarely make Bloom's cognitive levels an explicit organizing principle for task design and assessment in this domain (Doronina, 2024; Andriichuk, 2024). Bloom's Taxonomy classifies cognitive processes from remembering to creating, supporting design of objectives, activities, and assessments that move learners toward deeper learning and transfer (Adams, 2015). Revised versions stress the distinction between lower-order thinking skills (LOTS)—remember, understand, apply—and higher-order thinking skills (HOTS)—analyze, evaluate, create (Balatska, 2025).

Within language education, Bloom's Taxonomy has been employed to design learning objectives, assessment criteria, and instructional tasks that promote deeper cognitive engagement (Forehand, 2010; Krathwohl, 2002). Nonetheless, existing studies largely examine its application in general education contexts or in teaching isolated language skills, such as reading comprehension or writing, rather than in discipline-specific foreign language instruction for humanities students. As a result, there is a notable lack of empirical and methodological research addressing how Bloom's cognitive levels can be systematically aligned with the intellectual practices of historical inquiry. This gap is particularly evident in foreign language courses designed for history students, where analytical reading of historical texts, critical evaluation of sources, and academic argumentation are central learning outcomes. While historical thinking inherently involves higher-order cognitive processes, foreign language pedagogy has not sufficiently leveraged Bloom's Taxonomy as an organizing framework to support these processes in a structured and pedagogically coherent manner. Consequently, language instruction often fails to fully contribute to the development of students' disciplinary cognition.

Bloom's model is used not simply as a list of verbs, but as a scaffold for sequencing cognitive demands and aligning content, process, and assessment in foreign language tasks (Rahmani, 2023; Luo, 2025). Within language education, Bloom's levels are interpreted through constructivist and CLIL-informed perspectives that emphasize active meaning-making, problem solving, and the integration of content knowledge with linguistic development (Andriichuk, 2024). Accordingly, the purpose of this study is to examine the pedagogical potential of applying Bloom's Taxonomy to foreign language instruction for history students in higher education. Specifically, the study aims to identify how taxonomy-based instructional design can facilitate the development of both linguistic competence and higher-order cognitive skills relevant to historical studies. Through this approach, the research seeks to contribute to the theoretical and methodological advancement of discipline-oriented.

Review of Related Literature

Bloom's Taxonomy has remained a cornerstone of educational theory since its original formulation, with Anderson and Krathwohl's (2001) revision providing a modern framework for categorizing learning objectives. Krathwohl (2002) offered a comprehensive overview of this revision, emphasizing its applicability to teaching and assessment. Adams (2015) and Amer (2017) further reflected on the taxonomy's cognitive dimensions, highlighting its relevance in structuring learning outcomes across disciplines. Recent scholarship has expanded Bloom's framework into diverse educational contexts. Adhikari (2024) reviewed the revised taxonomy, while Balatska and Vyslobodska (2025) critically examined its advantages and limitations. Cai (2024) integrated Bloom's Taxonomy with the Cognitive Academic Language Learning Approach in college English

teaching, and Doronina et al. (2024) applied it to ESP curricula in higher education. Köksal, Ulum, and Yürük (2023) explored its role in reading texts for EFL/ESL learners, while Oran and Avcı (2024) analyzed assessment questions in Turkish language teaching through its lens.

The taxonomy's adaptability to digital and AI-driven learning environments has also been emphasized. Luo et al. (2025) proposed an enhanced version for fostering information literacy in the era of large language models. Rahmani and Ghounane (2023) examined its role in digitalizing EFL course content, and Nurmatova and Altun (2023) reviewed its integration for novice educators. Tsulaia (2025) demonstrated practical classroom applications for EFL learners, underscoring its pedagogical utility.

Collectively, these studies reveal Bloom's Taxonomy as both a theoretical foundation and a flexible tool for modern pedagogy. Its application ranges from traditional curriculum design to digital learning innovations, underscoring its enduring relevance in fostering cognitive development, language education, and information literacy.

Objectives

This study aims to examine the pedagogical potential of applying Bloom's Taxonomy to foreign language instruction for history students in higher education. Specifically, it seeks to identify how taxonomy-based instructional design can foster both linguistic competence and higher-order cognitive skills—such as analytical reading, source evaluation, and academic argumentation—essential for historical inquiry.

Methodology

Research Design

This study employs a qualitative, conceptual, and design-oriented research design aimed at examining foreign language instruction for history students through the cognitive framework of Bloom's Taxonomy. Rather than investigating instructional effects through experimental or quasi-experimental methods, the research focuses on theoretical analysis and pedagogical modelling, which are widely accepted approaches in educational and applied linguistics scholarship. This design is particularly appropriate for addressing complex cognitive–pedagogical relationships that cannot be adequately captured through quantitative measurement alone.

The conceptual research design enables the systematic synthesis of interdisciplinary theories drawn from foreign language pedagogy, cognitive psychology, and history education. By integrating Bloom's Taxonomy with discipline-specific language learning objectives, the study conceptualizes foreign language instruction as a cognitively structured process aligned with the intellectual practices of historical inquiry. This approach allows for an in-depth examination of how hierarchical cognitive levels can guide instructional planning, task design, and learning outcomes in language courses for history students.

A design-oriented perspective further supports the development of a taxonomy-based instructional framework that can be adapted to diverse higher education contexts. Through analytical abstraction and model construction, the study moves beyond descriptive analysis to propose a pedagogically coherent structure that links cognitive processes, language skills, and historical competencies. Such an approach contributes to

methodological innovation in foreign language education by offering a theoretically grounded model rather than context-bound instructional prescriptions.

Overall, the chosen research design ensures conceptual rigor, theoretical coherence, and academic relevance. It positions the study as a methodological contribution to the field of foreign language teaching in higher education, particularly within discipline-oriented and cognitively informed instructional paradigms.

Data Sources

The present study is grounded in a systematic examination of peer-reviewed scholarly literature and internationally recognized research outputs indexed in academic databases such as Scopus or equivalent scientific repositories. To underpin the conceptual model developed in this article, data sources were selected according to their theoretical relevance to Bloom's Taxonomy, cognitive structures in language pedagogy, and the design of foreign language instruction across higher education contexts. The literature review includes both foundational works on Bloom's Taxonomy and contemporary studies that operationalize cognitive frameworks in language teaching, ensuring comprehensive coverage of relevant research trends.

A core theoretical reference is the body of work on Bloom's Taxonomy itself, including conceptual discussions of the cognitive domain and its revised version, which remain central to educational objective classification. Although the original foundational texts by Bloom and later revisions by Anderson and Krathwohl are often cited as books rather than journal articles, recent implementations of Bloom's Taxonomy in foreign language settings are documented in peer-reviewed articles such as Tsulaia's study on crafting classroom activities for EFL learners using Bloom's cognitive levels (Tsulaia, 2025). This article illustrates how cognitive categorization can be translated into pedagogy, emphasizing higher-order thinking processes that align with the taxonomy's hierarchical structure.

Further empirical and analytical perspectives include research on how Bloom's Taxonomy is applied to enhance digitalized foreign language course content, revealing its role in structuring learning objectives and instructional outcomes (Rahmani & Ghounane, 2023). This study, although focused on content digitalization, demonstrates the broader applicability of Bloom's cognitive framework in aligning curriculum goals with learning processes. Additionally, literature examining Bloom's taxonomy in foreign language contexts emphasizes its contribution to cognitive development and critical thinking in EFL environments, supporting the rationale for its integration into discipline-oriented instruction.

One of the recent reviews highlight how Bloom's framework supports cognitive skill development and instructional effectiveness in EFL and ESP settings, while also revealing challenges in mapping higher-order thinking skills onto language curricula. Nurmatova & Altun states that integrating Bloom's Taxonomy into EFL teaching methods empowers novice teachers to create more organized, diverse, and student-oriented lessons, leading to improved language learning outcomes and teaching effectiveness (Nurmatova & Altun, 2023). The integration of Bloom's Taxonomy in EFL teaching is particularly valuable because it helps novice teacher's move beyond mechanical instruction toward purposeful cognitive engagement. When systematically applied, it not only improves lesson

coherence but also fosters higher-order thinking skills that are essential for sustainable language development.

The revised Bloom's Taxonomy of Educational Objectives enhances educational practices and outcomes by integrating knowledge and cognitive process dimensions, while also addressing challenges and controversies in contemporary contexts (Adhikari, 2024). The revised Bloom's Taxonomy is especially effective because it offers a more holistic framework that links types of knowledge with cognitive processes, allowing teachers to plan instruction more systematically. At the same time, acknowledging its challenges and debates makes its application more flexible and context-sensitive in contemporary educational settings.

Applying Bloom's taxonomy to practical English for Specific Purposes (ESP) classes for IT students in higher education improves engagement, higher-order thinking skills, and enables them to become proficient language users and critical thinkers (Doronina, 2024). Just as Bloom's Taxonomy enhances practical ESP classes for IT students, its application can be equally effective for history students by promoting analytical reading, critical interpretation of sources, and evidence-based argumentation in English. By progressing from basic comprehension of historical texts to evaluation and creation, history students become more engaged, proficient language users and develop the critical thinking skills essential for their discipline. Studies within these frameworks demonstrate practical approaches to lesson planning, task design, and assessment that can inform a discipline-sensitive application of Bloom's Taxonomy for history students.

To frame this study's analytical scope, the selected data sources were also reviewed for methodological rigor and relevance to curriculum design, ensuring that the emerging framework aligns with established theoretical positions and can be generalized to the specific syllabus. The sample instructional topics used in this study, such as Independence of Uzbekistan and Appearance and Character: The Character Traits of Leaders of History were drawn from the History specialty curriculum and syllabuses of the University of Innovation Technologies, ensuring relevance to actual educational contexts. The historical topics covered in the semester provide a context in which Bloom's cognitive levels can be systematically linked to language tasks that progress from basic linguistic recall to complex interpretative production, consistent with findings from the reviewed literature.

Analysis

The analysis of the selected literature was conducted using a combination of thematic content analysis, comparative theoretical analysis, and framework synthesis. First, all sources were examined to extract key concepts related to Bloom's Taxonomy, foreign language pedagogy, and cognitive skill development. Thematic coding was applied to identify patterns in how different cognitive levels—remembering, understanding, applying, analyzing, evaluating, and creating—are operationalized in instructional practices, particularly in discipline-specific contexts such as history. This step ensured that the analysis captured both the theoretical principles and practical applications of Bloom's framework in language education.

Second, a comparative theoretical analysis was performed to evaluate similarities and differences across the reviewed studies. This involved comparing approaches in general EFL/ESP instruction with studies focusing on content-based or discipline-oriented

teaching. Particular attention was given to how cognitive objectives were aligned with curricular content, learning outcomes, and skill development. This comparison allowed for the identification of gaps in the literature, such as the lack of systematic integration of Bloom's cognitive levels into history-oriented foreign language instruction, and highlighted strategies that could be adapted for this specific educational context.

Finally, the study employed framework synthesis to develop a conceptual model for implementing Bloom's Taxonomy in foreign language instruction for history students. Insights from the thematic and comparative analyses were mapped onto the semester topics, such as Independence of Uzbekistan, Historical games and sports, and Historical educational institutes, to illustrate how language tasks can progressively target lower- to higher-order cognitive skills. This process resulted in a taxonomy-based instructional framework that links language learning objectives with historical content, ensuring that students not only acquire linguistic competence but also develop analytical, evaluative, and creative skills relevant to historical inquiry.

Theoretical Modeling: Development of the Conceptual Framework

The conceptual framework of this study was developed to systematize foreign language instruction for history students through the pedagogically informed application of Bloom's revised taxonomy. The framework is designed to integrate cognitive development with language learning and disciplinary historical thinking, providing a coherent model for aligning linguistic objectives with the intellectual demands of history education in higher education contexts.

At the theoretical level, Bloom's taxonomy functions as the central organizing principle of the framework. The six cognitive levels—remembering, understanding, applying, analyzing, evaluating, and creating—are conceptualized as a hierarchical instructional scaffold that guides the sequencing of language tasks. Each cognitive level is explicitly mapped onto core foreign language skills (reading, listening, speaking, and writing) and essential historical competencies, including factual comprehension, source interpretation, contextual analysis, comparative reasoning, and argumentation. This mapping ensures that language instruction simultaneously supports communicative competence and historical cognition. The framework is grounded in the assumption that foreign language learning for history students is most effective when linguistic complexity develops in parallel with cognitive and disciplinary complexity. Accordingly, lower-order cognitive levels emphasize the acquisition and controlled use of vocabulary and grammatical structures within historically meaningful contexts, while higher-order levels prioritize interpretive, evaluative, and productive language use. This progression reflects a shift from form-focused instruction toward cognitively demanding, meaning-centered language practices relevant to historical inquiry.

To demonstrate the operationalization of the conceptual framework, the model is illustratively applied to a single instructional topic: "Appearance and Character: The Character Traits of Leaders of History" (grammar focus: adjectives). This topic serves solely as an example to show how Bloom's cognitive levels can be translated into language tasks that foster both linguistic development and historical thinking at the B1–B2 proficiency levels. The illustrative application does not limit the scope of the framework, which is intended to be adaptable to a wide range of historical themes and curricular units.

Overall, the proposed conceptual framework offers a theoretically coherent and transferable model for foreign language instruction in history-oriented programs. By systematically aligning Bloom's taxonomy with language skills and historical competencies, the framework provides a foundation for curriculum design, task development, and learning outcome formulation in non-experimental, theory-driven research.

Validity and Rigor

The academic rigor of this study was ensured by using only peer-reviewed scientific sources, such as journal articles and academic books published by international researchers. All sources were carefully selected to ensure reliability and relevance to foreign language teaching, Bloom's Taxonomy, and history education. This approach helps guarantee that the ideas and conclusions of the study are based on well-established and trustworthy research.

Rigor was also supported through the use of several theoretical frameworks instead of only one. Bloom's Taxonomy was combined with theories from foreign language education and history teaching. By comparing and connecting these frameworks, the study provides a balanced and well-supported theoretical model. This method reduces subjectivity and helps show clear links between cognitive levels, language skills, and historical thinking skills.

Ethical Considerations

Since the research is theoretical and does not involve students, teachers, or experiments, no ethical approval was required. All sources were properly cited, and academic honesty was maintained throughout the study. These measures ensure that the research is valid, ethical, and suitable for publication in international academic journals.

Findings and Discussion

The primary outcome of this study is a taxonomy-based conceptual model for foreign language instruction tailored to history students in higher education. The model integrates three interrelated dimensions: cognitive processes (based on Bloom's revised taxonomy), foreign language skills (reading, writing, listening, speaking), and historical competencies (factual comprehension, source analysis, interpretation, and argumentation). This conceptual model was derived from thematic content analysis, comparative theoretical analysis, and framework synthesis of peer-reviewed literature, ensuring that linguistic development and historical thinking are simultaneously supported.

Bloom's cognitive levels provide a hierarchical instructional scaffold, guiding the sequencing of language tasks from lower-order to higher-order skills. At lower levels, tasks emphasize vocabulary acquisition, grammatical accuracy, and recognition of historical information. As learners progress, tasks increasingly involve interpretive and evaluative language use, culminating in the production of original, evidence-based outputs. The integration of language skills with historical competencies ensures that students not only acquire linguistic knowledge but also develop critical thinking, analysis, and synthesis skills necessary for historical inquiry.

To demonstrate the internal logic and pedagogical coherence of the model, Bloom's taxonomy is illustrated through one representative instructional topic: Appearance and

Character: The Character Traits of Leaders of History (grammar focus: adjectives). This topic was selected because it naturally integrates linguistic description, historical interpretation, and evaluative judgment, making it suitable for operationalizing all cognitive levels within a single instructional unit.

At the remembering level, learners recognize and recall descriptive adjectives (e.g., brave, authoritative, strategic, charismatic) and basic factual information about selected historical leaders. Reading and listening activities focus on form recognition and factual identification, while historical competence is limited to noting key attributes of leaders.

The understanding level involves summarizing short texts or explaining leaders' traits in learners' own words. Speaking and writing activities encourage coherent expression of ideas, while historical understanding is reflected in interpreting how specific traits influenced leaders' actions and reputations.

At the applying level, learners use acquired vocabulary and grammar in contextualized tasks such as short oral presentations or written paragraphs. Listening activities require identifying descriptive details in historical narratives. Historical application is emphasized by connecting character traits to concrete historical events or decisions.

The analyzing level requires learners to compare and contrast the traits of different historical leaders. Guided reading and writing tasks focus on identifying patterns, differences, and cause–effect relationships, linking linguistic structures with analytical reasoning in history.

At the evaluating level, learners make reasoned judgments about leaders, justifying their opinions in oral or written form. This stage integrates argumentation and critical evaluation of historical evidence, reflecting both advanced language proficiency and higher-order historical thinking.

Finally, at the creating level, learners produce original content synthesizing linguistic and historical knowledge, such as a short biographical profile, reflective essay, or simulated interview with a historical leader. This level activates all four-language skills and demonstrates advanced historical reasoning and interpretive ability.

In sum, the conceptual model demonstrates how Bloom's Taxonomy can be systematically embedded within discipline-specific foreign language instruction, ensuring progressive cognitive and linguistic development. While the illustrative topic provides a concrete example, the model is transferable to diverse historical subjects and instructional contexts, offering a theoretically grounded framework for curriculum design, task sequencing, and learning outcome alignment in higher education.

Table 1. Operationalization of Bloom's Taxonomy in Foreign Language Instruction for History Students (Illustrative Topic: "Appearance and Character: Leaders' Traits").

Bloom's Level	Language Skills	Historical Competencies	Example Tasks
Remembering	Reading, Listening	Recognize key traits; recall basic facts	Identify adjectives describing historical leaders in short texts or audio excerpts

Understanding	Speaking, Writing	Interpret character traits; explain historical significance	Summarize texts about leaders' traits; paraphrase in own words using appropriate adjectives
Applying	Speaking, Writing, Listening	Connect traits to events; contextual application	Describe a leader's character in oral presentations or written paragraphs; identify traits in narratives
Analyzing	Reading, Writing, Speaking	Compare and contrast traits; examine cause–effect	Compare leaders' qualities; organize information in tables or charts; discuss differences in groups
Evaluating	Speaking, Writing	Justify judgments; assess historical impact	Argue which traits influenced leadership effectiveness; support with textual evidence
Creating	Reading, Writing, Speaking, Listening	Synthesize knowledge; produce original interpretation	Write a biographical profile, reflective essay, or simulated interview; integrate descriptive language and historical analysis

The results of this study demonstrate that Bloom's Taxonomy can serve as a coherent framework for structuring foreign language instruction for history students. By integrating cognitive levels with language skills and historical competencies, the conceptual model addresses the dual demands of linguistic development and disciplinary thinking. This approach aligns with prior research emphasizing the value of cognitive frameworks in ESP and CLIL settings (Adams, 2015; Krathwohl, 2002; Rahmani, 2023), while extending it to discipline-specific instruction for humanities students, a gap noted in the literature.

The illustrative application to the topic *"Appearance and Character: The Character Traits of Leaders of History"* confirms that taxonomy-based instructional design can effectively scaffold learning from lower-order to higher-order thinking. At the remembering and understanding levels, learners acquire foundational vocabulary and grammatical structures while interpreting factual historical information. At higher-order levels, tasks encourage analysis, evaluation, and creation, fostering complex historical reasoning and language production simultaneously. This progression reflects the theoretical premise that meaningful language learning is closely tied to cognitive engagement with subject content (Forehand, 2010; Andriichuk, 2024).

Comparison with existing studies highlights the distinctiveness of this approach. While previous research has applied Bloom's Taxonomy to general EFL or ESP contexts, few studies have systematically operationalized it for history students, aligning each cognitive level with disciplinary practices such as source interpretation, critical evaluation, and historical argumentation. The model presented here demonstrates that integrating Bloom's levels into curriculum design provides both conceptual clarity and practical adaptability, ensuring that learners develop higher-order thinking skills in tandem with language competence.

Methodologically, the study reinforces the importance of theoretical triangulation. By combining insights from cognitive psychology, language pedagogy, and history education, the framework offers a robust basis for curriculum planning and task design. Moreover, the model's adaptability to different historical topics, proficiency levels, and instructional contexts enhances its generalizability, making it suitable for both traditional and digitally mediated learning environments.

Finally, the study highlights the pedagogical implications of taxonomy-informed instruction. Instructors can design activities that sequentially develop language and historical thinking, moving learners beyond rote memorization to analytical, evaluative, and creative engagement. Such an approach not only improves language proficiency but also cultivates critical thinking, evidence-based argumentation, and disciplinary literacy, addressing core objectives of higher education in history programs.

Conclusion

This study developed a taxonomy-based conceptual framework for foreign language instruction aimed at history students, integrating Bloom's revised cognitive levels with language skills and historical competencies. The model demonstrates that foreign language learning can be systematically aligned with disciplinary thinking, allowing students to progress from foundational vocabulary and grammatical skills to higher-order cognitive tasks such as analysis, evaluation, and creation.

The illustrative application to the topic "Appearance and Character: The Character Traits of Leaders of History" demonstrates the practical feasibility of the model. By mapping each cognitive level to specific tasks and learning outcomes, the framework provides instructors with a structured approach to developing both language proficiency and historical reasoning skills. Importantly, the framework is flexible and transferable across different topics, historical periods, and educational contexts.

In conclusion, this study contributes to the theoretical and methodological literature by offering a discipline-sensitive, cognition-informed model for foreign language teaching in higher education. Future research should empirically validate this framework in classroom settings, exploring its impact on learners' linguistic development, historical thinking, and overall academic engagement. Additionally, the model could be adapted to other humanities disciplines, enhancing its utility for broader ESP and CLIL applications.

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Linguopoetic and Linguacultural Features of William Shakespeare's Sonnet 1 in I. Yusupov's Karakalpak Translation

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Abstract

This article investigates the linguopoetic and linguacultural features of William Shakespeare's Sonnet 1 in its Karakalpak translation by I. Yusupov. In particular, the study analyses conceptual vocabulary, metaphorical systems, phraseological units, poetic structure, and syntactic organization. Furthermore, it explores how the translator adapts the original text to the cultural and linguistic norms of the Karakalpak language. Using comparative, descriptive, linguopoetic, and linguacultural methods, the research demonstrates that the translation preserves the semantic core of the original while introducing structural and stylistic transformations. Moreover, culturally specific imagery enhances the expressive and communicative impact of the text. Consequently, the translation is interpreted as a creative and culturally embedded reinterpretation rather than a literal reproduction.

Keywords: Linguacultural, Linguopoetics, Metaphor, Phraseology, Translation

Introduction

In contemporary translation studies, increasing attention is paid to the interaction between linguistic form and cultural meaning. In this respect, the works of William Shakespeare have been translated into nearly eighty languages, thus demonstrating their universal significance. At the same time, in the Karakalpak literary tradition, the translations of I. Yusupov occupy a central place, especially regarding Shakespeare's sonnets. Although Shakespeare's works have been translated into Uzbek, Russian, and Kazakh, it is important to note that many translations were mediated through Russian versions rather than the English original. However, Yusupov's translation stands out due to its relative independence and creative reinterpretation of the source text. In particular, while translators such as Samuil Marshak are recognized for their closeness to the original, Yusupov deliberately departs from strict equivalence in favour of cultural adaptation. Therefore, the aim of this study is to analyze the linguopoetic and linguacultural transformations present in Yusupov's translation of Sonnet 1. Specifically, the research seeks to identify how lexical, stylistic, and cultural elements are reinterpreted within the Karakalpak linguistic framework.

Review of Related Literature

The study of Shakespeare's sonnets has long attracted scholarly and translational attention, with works such as Leishman (2013) exploring themes and variations across the sonnet sequence, and Burrow's Oxford edition (2002) providing authoritative textual grounding. These contributions highlight the universal significance of Shakespeare's poetry and its adaptability across cultures and languages.

In the Central Asian context, translations into Uzbek, Karakalpak, and Russian have played a crucial role in disseminating Shakespeare's works. Karabayev's translation (Sonetler, 1981) and the Uzbek edition (Bir qatim nur, 2012) reflect mediated interpretations often influenced by Russian versions. Marshak's Russian translations (2018; 1993) are widely recognized for their fidelity to the original, offering a benchmark for comparative analysis. However, Yusupov's Mängi bulaklar (1985) stands out for its creative independence, deliberately departing from strict equivalence to achieve cultural adaptation within the Karakalpak literary tradition.

Theoretical perspectives on translation further enrich this discourse. Larson (1993) emphasizes meaning-based translation, while Ilyushina (2015) outlines key concepts and challenges in translation theory. Kruzkov (1918) provides early reflections on Shakespeare's sonnets, situating them within broader literary debates. Together, these works underscore the tension between linguistic fidelity and cultural reinterpretation in translation practice.

Overall, the literature demonstrates a dual trajectory: global scholarship that situates Shakespeare's sonnets within universal literary traditions, and localized translations that adapt them to specific cultural frameworks. This convergence highlights the importance of analyzing linguopoetic transformations and cultural adaptation in Yusupov's Karakalpak translation, offering insights into how canonical texts are reimagined across languages and traditions.

Objectives

This study aims to analyze the linguopoetic and linguacultural transformations in I. Yusupov's translation of Shakespeare's Sonnet 1 into the Karakalpak literary tradition. While Shakespeare's works have been translated into nearly eighty languages, many Central Asian versions were mediated through Russian translations rather than the English originals. Yusupov's work stands out for its relative independence, offering a creative reinterpretation that departs from strict equivalence in favour of cultural adaptation. The objective is to examine how lexical choices, stylistic devices, and cultural elements are reshaped within the Karakalpak linguistic framework.

Another objective is to compare Yusupov's translation strategies with those of other translators, such as Samuil Marshak, who are noted for their closeness to the source text. By highlighting Yusupov's deliberate departure from literal fidelity, the study seeks to reveal how translation can serve as a medium for cultural dialogue, embedding Shakespeare's universal themes into the local literary and cultural context. Ultimately, the research intends to provide insights into the dynamics of translation studies by demonstrating how linguistic form and cultural meaning interact in the adaptation of canonical works across languages and traditions.

Methodology

In order to achieve the objectives of the present study, a comprehensive and multi-layered methodological framework was employed. First, William Shakespeare bases the research on a comparative-analytical approach, since it examines Sonnet 1 alongside its Karakalpak translation by I. Yusupov. Thus, the comparison enables the identification of both structural correspondences and transformation strategies between the source and target texts. Furthermore, the study applies a descriptive method, which allows for the systematic observation of linguistic phenomena such as lexical units, phraseological expressions, metaphors, and syntactic constructions. In particular, attention is paid to how these elements function within the poetic structure and how they are modified in translation. At the same time, descriptive analysis helps to reveal the internal organization of the translated text and its stylistic coherence. In addition, a linguopoetic analysis is employed; consequently, the research focuses on poetic devices such as epithets, parallelisms, rhythm, and rhyme schemes. Through this method, it becomes possible to examine how the aesthetic and expressive features of the original sonnet are preserved, transformed, or recreated in the Karakalpak version. Moreover, special emphasis is placed on the interaction between form and meaning, since poetic language inherently combines both dimensions. Equally important is the linguacultural approach, which is used to identify culturally specific elements embedded in the translation. For instance, culturally marked concepts such as folklore-based imagery and environment-related metaphors are analysed in relation to the Karakalpak worldview. Therefore, this approach allows the researcher to interpret translation not merely as a linguistic act, but also as a process of cultural adaptation and reinterpretation. Moreover, the study incorporates contextual and interpretative analysis. On the one hand, the meanings of individual lexical and stylistic units are examined within their immediate textual environment. On the other hand, broader cultural and literary contexts are considered in order to explain the translator's choices. As a result, the analysis moves beyond surface-level comparison and provides deeper insight into the semantic and pragmatic dimensions of the translation. Finally, a functional approach is applied; accordingly, the research evaluates how effectively the translated text fulfils its communicative and aesthetic functions for the target audience. In this regard, particular attention is given to readability, emotional impact, and cultural accessibility. Thus, the methodology combines structural, semantic, and functional perspectives, ensuring a holistic and well-grounded analysis. In summary, by integrating comparative, descriptive, linguopoetic, linguacultural, and functional methods, the study provides a detailed and coherent examination of translation processes, while simultaneously highlighting the dynamic interaction between language and culture.

Analysis

The results of the present study clearly demonstrate that the Karakalpak translation of Sonnet 1 by I. Yusupov is characterized by a high degree of linguistic transformation combined with semantic preservation. In other words, although the formal structure of the original text by William Shakespeare is not strictly maintained, its conceptual and philosophical core is successfully conveyed through culturally adapted expressive means.

First, the analysis shows that one of the most prominent features of Yusupov's translation is semantic compression and redistribution. For instance, the translator combines the meaning of two original lines into a single line:

"Jıl qusınday bir jılt etip sen bugin" ("Like a year-bird you flash today")

Thus, the metaphorical expressions found in the original—such as “ornament of the day” and “herald of spring”—are not translated literally. Instead, they are replaced with the culturally specific image of the “year bird” (jıl qusı), which in Karakalpak folklore symbolizes the arrival of spring. Consequently, the translator achieves semantic equivalence through cultural substitution rather than direct lexical correspondence.

Secondly, the results indicate a significant use of phraseological expansion. In particular, the original phrase “burying the future in the bud” is rendered as:
“Biynıshan keterseń erteń, bilseń sen,
Keleshegiń quwrar jarmay búrtigiń”

Here, a single compact idea in the source text is expanded into two emotionally rich lines. Moreover, the translator intensifies the expressive effect by adding an additional line that is absent in the original:
“Suwǵarılıp egilmegen shólseń sen” (“You are like an unwatered, unsown desert”)

Therefore, the concept of unrealized potential is reinforced through the culturally significant image of the desert (shól), which reflects the geographical and cultural reality of the Karakalpak people.

Furthermore, the study identifies a range of linguoculturally marked expressions introduced by the translator. Among them are:
“jıl qusınday” (like a year bird)
“biynıshan keterseń” (you will disappear without a trace)
“búrtik jarmay” (without blossoming)
“suwǵarılıp egilmegen shól” (an unsown, unwatered desert)

These units do not have direct equivalents in the English original; however, they effectively convey its meaning while embedding it within the Karakalpak cultural and cognitive framework. Thus, the translation demonstrates a shift from universal metaphorical imagery to nationally specific symbolic representation.

In addition, the results reveal that contrast (antithesis) remains a central poetic device in both the original and the translation. Specifically, the opposition between natural renewal and human sterility is preserved, although it is expressed through different lexical and cultural means. Consequently, the philosophical depth of the sonnet is maintained despite structural modifications.

Another important finding concerns the syntactic and stylistic transformation of the text. Initially, the sonnet presents general philosophical reflections; however, in later lines, it shifts toward direct address. Notably, this stylistic progression is also preserved in the translation:
“Jıl qusınday bir jılt etip sen búgin,
Biynıshan keterseń erteń, bilseń sen”

Thus, the translator successfully reproduces the rhetorical movement from abstraction to personal appeal, which is essential to the original’s communicative effect.

Moreover, the analysis of poetic form shows that while the English iambic pentameter is not retained, it is replaced by a syllabic meter (10–11 syllables) typical of Karakalpak

poetry. As a result, the rhythm becomes more natural for the target audience, while still preserving the reflective tone of the sonnet.

Equally significant is the preservation and adaptation of the rhyme scheme. The translator maintains the structural pattern of the original quatrains; however, he enriches it with innovative and culturally influenced rhymes, including:

- verb-based rhymes: “bolıp / solıp”
- phrase-based rhymes: “sen búgin / búrtigiń”
- refrains: “bilseń sen / shólseń sen”

In particular, the use of refrain (redif) rhyme, which is typical of Eastern poetic traditions, represents a notable deviation from English and Russian norms. Nevertheless, this feature does not disrupt the harmony of the sonnet; on the contrary, it enhances its musicality and cultural resonance.

Finally, the results confirm that Yusupov’s translation is marked by creative independence. That is to say, the translator does not rigidly follow the source text but instead reconstructs it in accordance with the linguistic, stylistic, and cultural norms of the Karakalpak language. Consequently, the translated sonnet acquires a new artistic identity while remaining faithful to the original’s central idea.

In summary, the results demonstrate that the translation achieves a balance between semantic fidelity and cultural adaptation, thereby transforming Shakespeare’s sonnet into a work that is both recognizable and deeply rooted in Karakalpak literary tradition.

Findings and Discussion

The findings of the present study provide substantial evidence that the translation of Sonnet 1 by I. Yusupov should be interpreted not as a literal transfer of linguistic units, but rather as a complex act of intercultural mediation. In other words, the translation process involves not only the reproduction of meaning, but also its transformation in accordance with the cognitive, cultural, and aesthetic norms of the target language community. First, it is important to emphasize that the translator’s strategy reflects a clear preference for functional and semantic equivalence over formal equivalence. While the original text by William Shakespeare relies on specific lexical and syntactic patterns, Yusupov deliberately restructures these elements. However, despite these structural deviations, the core philosophical idea—namely, the transient nature of beauty and the necessity of continuity—is preserved. Therefore, the translation demonstrates that meaning can be retained even when form is significantly altered.

Furthermore, the use of culturally marked metaphors such as “year bird” and “desert” indicates a shift toward domestication, that is, the adaptation of the source text to the cultural expectations of the target audience. On the one hand, such substitutions may appear to distance the translation from the original imagery. On the other hand, they enhance the interpretability and emotional impact of the text for Karakalpak readers. Consequently, the translation achieves a higher degree of communicative effectiveness, which is one of the primary goals of literary translation. In addition, the expansion of phraseological units observed in the results section suggests that the translator employs a strategy of semantic amplification. That is to say, compact expressions in the source text are unfolded into more elaborate constructions in the target language. This phenomenon can be explained by the need to compensate for cultural and contextual differences. Thus,

amplification serves as a means of preserving not only denotative meaning, but also connotative and emotional nuances.

Moreover, the integration of elements characteristic of Eastern poetic traditions, particularly the use of refrain (redif) rhyme, highlights the hybrid nature of the translation. Although such features are not inherent in English sonnet structure, their inclusion does not distort the original work. On the contrary, they contribute to the creation of a new poetic system in which Western and Eastern traditions coexist. Therefore, the translation can be regarded as an example of interliterary synthesis, where different poetic conventions are harmoniously combined. Another significant aspect concerns the linguacultural reinterpretation of imagery. For instance, the metaphor of the desert, which plays a crucial role in the translation, reflects the environmental and historical experience of the Karakalpak people. As a result, the abstract philosophical idea of wasted potential is transformed into a concrete and culturally meaningful image. This observation confirms that translation is deeply influenced by the translator's cultural background and worldview.

At the same time, it should be noted that such a high degree of creative freedom raises questions about the boundaries of translation. Specifically, one may ask whether the introduction of new imagery and structural modifications risks altering the author's original intent. However, the analysis shows that these changes do not undermine the integrity of the source text. Instead, they enable the translator to recreate its essence in a form that is accessible and relevant to a different audience. Finally, the discussion highlights that Yusupov's translation exemplifies the concept of the translator as a co-creator. Rather than remaining invisible, the translator actively participates in the construction of meaning, thereby producing a text that belongs simultaneously to two literary traditions. Consequently, the translation should be viewed not merely as a derivative work, but as an independent artistic achievement.

In summary, the discussion confirms that the effectiveness of literary translation depends on the balance between fidelity and creativity. In this case, Yusupov successfully maintains this balance by preserving the philosophical depth of Shakespeare's sonnet while reinterpreting its linguistic and cultural form. Therefore, the translation stands as a compelling example of how global literary heritage can be integrated into local cultural contexts.

Conclusion

In conclusion, the present study has demonstrated that the Karakalpak translation of Sonnet 1 by I. Yusupov represents a highly sophisticated example of linguopoetic and linguacultural adaptation. First, it has been established that the translator does not aim at strict formal equivalence; rather, he prioritizes the preservation of semantic content and communicative value. Therefore, structural transformations such as compression, expansion, and reorganization of poetic lines serve as deliberate strategies rather than deviations. Furthermore, the analysis has shown that Yusupov actively employs culturally specific imagery, including folklore-based and environment-related metaphors, which significantly enhance the accessibility and emotional resonance of the translated text. As a result, universal philosophical ideas expressed by William Shakespeare are successfully reinterpreted within the Karakalpak cultural framework. Thus, the translation becomes not only understandable, but also deeply meaningful for the target audience.

In addition, it has been revealed that key linguopoetic features—such as metaphor, contrast, syntactic progression, rhythm, and rhyme—are not simply reproduced, but creatively transformed. In particular, the adaptation of poetic meter and the introduction of Eastern-style rhyme patterns demonstrate the translator's ability to harmonize different literary traditions. Consequently, the translated text retains its aesthetic integrity while acquiring new stylistic qualities. Moreover, the study confirms that translation, especially in the case of poetry, functions as a process of cultural negotiation and artistic recreation. That is to say, the translator operates as a co-creator who reconstructs meaning in accordance with the norms, expectations, and worldview of the target linguistic community. Hence, Yusupov's translation can be regarded as an independent literary achievement that bridges global and local traditions.

Finally, it can be concluded that the effectiveness of this translation lies in its balanced combination of fidelity and creativity. On the one hand, the philosophical depth and thematic essence of the original sonnet are preserved. On the other hand, the linguistic and cultural form is adapted to ensure relevance and expressiveness. Therefore, this work contributes not only to the study of Shakespearean translation, but also to broader discussions in linguistics, translation theory, and intercultural communication. Overall, the research confirms that successful poetic translation is achieved when linguistic precision is complemented by cultural sensitivity and creative interpretation.

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Didactic Opportunities of Virtual Laboratories in Biology Education and Their Effectiveness in the Educational Process

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Abstract
This study is aimed at identifying the didactic possibilities of using virtual laboratories in biology education and their influence on the effectiveness of the educational process. The research was conducted on the basis of a quasi-experimental design with the participation of 63 students. In the experimental group, the educational process was organized on the basis of PhET virtual laboratories, and in the control group - by traditional methods. Analysis of the results showed a significant increase in knowledge indicators in the experimental group ($p < 0.05$). The obtained results confirm that virtual laboratories are an effective didactic tool for increasing the effectiveness of biology education.

Keywords: Biology Education, Digital Learning, Didactic Potential, Learning Effectiveness, Virtual Laboratory

Introduction

The rapid digital transformation of higher education has significantly reshaped the teaching and learning landscape in science disciplines. In biology education, the increasing complexity of experimental procedures and the limited availability of physical laboratory resources have created a growing demand for innovative teaching solutions. Among these, virtual laboratories have emerged as powerful digital tools capable of supporting interactive, flexible, and student-centred learning environments.

Virtual laboratory technologies enable the simulation of biological experiments in a safe and controlled digital space, allowing students to repeatedly perform procedures, visualize complex processes, and engage in inquiry-based learning without time constraints, costs, or laboratory safety risks. Recent studies show that virtual laboratories improve students' ability to follow scientific procedures and understand complex concepts while providing a safe environment for experiments. Moreover, interactive virtual laboratories offer accessibility and flexibility in higher education and are increasingly integrated into natural science curricula worldwide.

In the context of the artificial intelligence era, such digital environments are gaining particular importance as higher education institutions seek to develop students' higher-order thinking and research competencies. However, despite the growing body of research on digital experimentation, the specific didactic mechanisms through which virtual laboratories contribute to the development of university students' research skills remain insufficiently theoretical.

Therefore, the objective of this study is to theoretically analyse the didactic potential of virtual laboratories in fostering research skills among university students in biology education and to propose methodological considerations for their effective integration into higher education practice.

Review of Related Literature

Research on the fauna and ecology of Karakalpakstan has been shaped by both regional and classical studies in zoology and biometry. Asenov, Jumanov, and Bekbergenova (2020) provide a comprehensive account of the vertebrate fauna of Karakalpakstan, documenting species diversity and ecological distribution. Their work builds on earlier studies of the animal world in the region, offering updated insights into biodiversity and conservation challenges. Similarly, Jumanov and Asenov (2020) expand this perspective in The Animal World of Karakalpakstan, presenting detailed observations on local ecosystems and their vertebrate populations.

Methodological contributions to ecological research are evident in the works of G.F. However, whose studies on biometry (1990, 2020) provide essential tools for analyzing animal populations and ecological data. Biometry has been crucial in quantifying species variation, population dynamics, and ecological interactions, thereby supporting more precise conservation strategies. These statistical approaches complement field-based observations, ensuring that ecological studies are grounded in both empirical and analytical rigor.

Classical ecological research by Novikov (1953) remains influential, particularly his field studies on terrestrial vertebrates. Novikov emphasized the importance of systematic fieldwork in understanding ecological relationships, predator-prey dynamics, and habitat structures. His methodological framework continues to inform modern ecological studies, including those conducted in Karakalpakstan.

Taken together, the literature demonstrates a dual trajectory: regional studies that document the biodiversity of Karakalpakstan and foundational works that provide methodological and theoretical frameworks for ecological research. The integration of biometry, field ecology, and regional fauna studies underscores the importance of combining quantitative analysis with field observation. This convergence highlights the need for continued research to preserve biodiversity and strengthen ecological monitoring in Karakalpakstan’s unique environment.

Objectives

This study seeks to theoretically analyse the didactic potential of virtual laboratories in fostering research skills among university students in biology education. With the rapid digital transformation of higher education and the increasing complexity of biological experiments, virtual laboratories provide interactive, flexible, and student-centered environments that overcome limitations of physical resources, safety concerns, and cost.

The research aims to explore how these digital tools support inquiry-based learning, repeated experimentation, and visualization of complex biological processes, thereby enhancing students' scientific understanding and procedural competence.

Another objective is to examine the specific mechanisms through which virtual laboratories contribute to the development of higher-order thinking and research competencies. Drawing on established theoretical frameworks such as the Depth of Processing Theory, the Comprehensible Output Hypothesis, and Vygotsky's Scaffolding Theory, the study intends to identify how AI-enabled digital environments can promote deeper cognitive engagement, contextualized practice, and individualized learning support.

Finally, the research aims to propose methodological considerations for effectively integrating virtual laboratories into higher education practice. By comparing traditional laboratory approaches with AI-mediated digital experimentation, the study seeks to provide empirical and theoretical insights that inform curriculum design, teaching strategies, and policy development. Ultimately, the objective is to demonstrate how virtual laboratories can serve as transformative pedagogical tools for advancing research skills and preparing students for the demands of modern scientific inquiry.

Methodology

In the research work, the method of pedagogical experiment was used to determine the effectiveness of using virtual laboratories in biology education. The experimental study was conducted with the participation of students of the biological education program of a higher educational institution.

A total of 63 students participated in the study. They were divided into two groups based on random sampling: the experimental group (31 people) and the control group (32 people). In the experimental group, virtual laboratory technologies were used in the educational process, while in the control group, traditional laboratory classes were organized.

The following methods were used in the research process:

- pedagogical observation
- test trials
- questionnaire requests
- statistical analysis methods

This approach made it possible to comprehensively assess the effectiveness of education.

Modern digital educational platforms and interactive simulations were used as a virtual laboratory environment. In this case, special attention was paid to the students' skills in conducting independent experiments, modelling, and analyzing the results.

The research methodology was based on scientific recommendations for organizing a pedagogical experiment (Lakin, 1990; Novikov, 1953).

Analysis

In order to accurately assess the results of the pedagogical experiment, the level of knowledge of students in the experimental and control groups was analysed as a

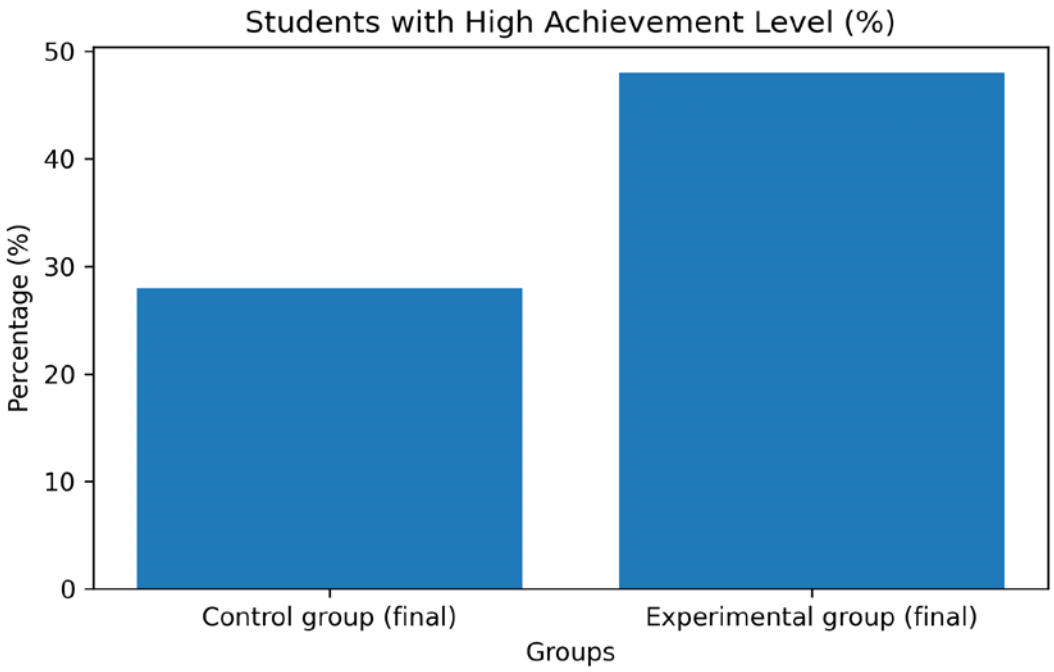
percentage. At the beginning of the experiment, it was found that the indicators of both groups were practically equal, which indicates that the groups were correctly selected for comparison. At the end of the experiment, positive dynamics were clearly manifested in the experimental group.

Table 1. Dynamics of student achievement (%).

Indicator	Control group (n=32)	Experimental group (n=31)
High level at the beginning of the experiment	21%	22%
Average at the beginning of the experiment	47%	45%
Low level at the beginning of the experiment	32%	33%
High level at the end of the experiment	28%	48%
Average at the end of the experiment	50%	42%
Low level at the end of the experiment	22%	10%

As can be seen from the table data, at the beginning of the experiment, the indicators of both groups were close to each other. This circumstance confirms the objective organization of the pedagogical experiment. At the end of the experiment, it was observed that the share of high assimilation in the experimental group increased from 22% to 48%, i.e., the increase was 26 percentage points. At the same time, the share of students with a low level decreased from 33% to 10%.

In the control group, positive changes were noted, but they were at a relatively low level. This situation shows that the use of virtual laboratories significantly increases the effectiveness of learning. The obtained results confirm the high didactic potential of the digital educational environment (Lakin, 1990; Novikov, 1953).



Statistical analysis (t-test) - In order to statistically verify the results of the experimental and control groups, Student's t-test was used. According to the calculation results, it was established that the high indicators of assimilation in the experimental group are significantly higher than in the control group ($t \approx 2.1$; $p < 0.05$). This shows that the use of virtual laboratory technologies statistically significantly increases the effectiveness of students' learning (Lakin, 1990; Novikov, 1953).

Findings and Discussion

The results of the pedagogical experiment showed that the use of virtual laboratories had a positive impact on the effectiveness of education.

At the beginning of the experiment, it was established that the level of knowledge of the students of both groups is close to each other. At the end of the experiment, a significant increase in assimilation indicators was observed in the experimental group.
Including:

- the share of high assimilation in the experimental group increases.
- the formation of practical skills accelerated.
- increased independent thinking activity

These results confirm that virtual laboratories enhance students' cognitive activity. The obtained results are consistent with modern research and show that the digital educational environment is highly effective in teaching applied sciences (Asenov et al., 2013; Jumanov et al., 2020).

Conclusion

The findings of this study clearly demonstrate that the integration of virtual laboratories into biology education significantly enhances the effectiveness of the learning process. Students in the experimental group showed marked improvements in knowledge assimilation, practical skill formation, and independent thinking compared to those taught through traditional methods. The statistical analysis confirmed that these improvements

were not incidental but the result of the didactic potential of digital laboratory environments, which provide safe, flexible, and interactive opportunities for inquiry-based learning.

Overall, the research highlights the transformative role of virtual laboratories in fostering higher-order thinking and research competencies among university students. By offering repeated experimentation, visualization of complex biological processes, and individualized learning support, these tools bridge the gap between theoretical knowledge and practical application. The study underscores the importance of systematically integrating virtual laboratories into higher education curricula as a means of preparing students for modern scientific inquiry and advancing the quality of biology education.

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A Study on the Mechanisms of Practical Knowledge Transformation among Higher Education Dance Instructors from an Embodied Cognition Perspective

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Abstract

In recent years, dance education in higher education institutions has emphasised the integration of practical knowledge transformation and cognitive processes. However, there is a limited understanding regarding the value of practical academic knowledge in assisting higher education dance teachers from the standpoint of embodied cognition. As a result, the purpose of this research was to evaluate the processes of practical knowledge transformation in higher education dance teachers while taking the embodied cognitive viewpoint as a mediating factor. The researchers adopted a qualitative, cross-sectional study method to gather information from institutions all at once. Higher education dance teachers have reported an enhancement in confidence because of the increased understanding of the consequences of practical knowledge transformation. A thorough examination of symbolised teaching practices and strategies for knowledge transformation was conducted using primary data obtained through semi-structured interviews. Using the purposive sampling method, 267 dance teachers from higher education institutes in China were surveyed. The researcher used thematic analysis, which followed inductive coding, to find patterns and themes in the data. The research found that embodied cognition improved dance instructors' creativity, instructional effectiveness, and knowledge transmission through physical and emotional expression. It also indicated that sensory-motor systems might be more effective than theoretical approaches for dance students. It demonstrated that physical movement and emotional expression help teachers and students build reflective practice. This research showed that embodied cognition was crucial to practical transformative experience for higher education dance teachers.

Keywords: Dance Instructors, Dance Education, Embodied Cognition, Higher Education, Practical Knowledge Transformation

Introduction

The dynamic process by which dance teachers convert their theoretical knowledge, personal experiences, and embodied practice into successful teaching methods can be defined as practical knowledge transformation. Embodied cognition, in which knowledge is not only conceptualised but also physically taught through physical movement, bodily expression, and sensory awareness, is essential to this change in the context of dance education, particularly for higher education (Ren & Chu, 2024). Dance is an art form that entails collaboration of body and mind via low-level perception-action coupling and high-level

cognitive processes. The modifications in the practical knowledge of Chinese dance teachers are an essential factor in dance education at present. This transformation further improves the combination of theoretical concepts and embodied cognition. The embodied cognition paradigm claims that cognitive processes are grounded in physical experiences. The mental re-enactment of bodily movements is important for higher-level cognition in self-other interactions. The notion of embodied cognition is particularly pertinent to the discipline of dance training and provides a platform for the development of knowledge on how perceptual, multimodal techniques facilitate and augment learning (Bläsing, 2022).

The procedure of knowledge transformation of dance instructors by means of embodied cognition promotes the development, modification and expression of teaching knowledge via the body, rather than just with abstract thinking. From this approach, cognition is entangled with body movement, sensory awareness and relationships with the environment (Lindberg et al., 2023). Knowledge is not static or solely theoretical in the context of dance education. The knowledge and individual experiences of teachers are transferred to their students through physical engagement, such as body movement, rhythm, and space. When dance educators choreograph their students with appropriate posture, or facilitate expressive performance, they use embodied knowledge as a kind of comprehension retained in motor learning and sensory impression. This enables individuals to contemplate through movement, rather than only educate theoretical understanding vocally (Berg, 2023). It is also possible for embodied cognition to enable the transformation of tacit knowledge into forms that can be communicated. It is common for dance teachers to transform difficult, non-verbal experiences into easy and intelligible demonstrations or guided practice in order to make abstract movement aspects more accessible to their students. Basically, dance educators enrich their knowledge with the assistance of embodied cognition, which integrates direct physical experience with critical thinking. As a result, students learn more in-depth, and teachers can provide better guidance for their students via the development of contextualised competence in dance education (Korpinen, 2024).

Review of Related Literature

The dynamic process by which dance teachers integrate theoretical understanding, personal experience, and embodied practice into successful teaching tactics is known as practical knowledge transformation. This transformation is entrenched in embodied cognition, especially in the setting of dance education at the higher level, when knowledge is not only intellectually processed but also physically performed through physical movement, gesture, and sensory awareness (Bailey et al., 2026). On the other hand, dance instructors rely heavily on intuition, bodily awareness, and experiential knowledge, which are gradually developed over years of practice and teaching. They impart implicit knowledge to students through presentation, imitation, and feedback. In order to provide relevant, flexible, and context-sensitive dance instruction, dance educators undergo a constant, mindful, and embodied transformation of their practical knowledge. Several interconnected aspects, including reflective practice, sensorimotor integration, and cognitive-motor integration, altered practical competence among higher education dance instructors from an embodied cognition standpoint. Dance teachers employ emotional expression to enhance both performance and training. Furthermore, they use bodily expressiveness to transmit effective meaning, which aids student learning and participation (Cappello & Cañabate, 2025). In addition to this, physical practice of movements aids skill development by enhancing the integration of cognitive, sensory, and motor processes. Learners are encouraged to actively engage in the process, be inventive, and self-aware from this perspective, allowing them to develop meaning via

physical expression. As a result, learning to dance becomes an integrated process including mental, emotional, and physical elements. Through comparison, dancers use images to connect things in the world to the body. This mapping helps everyone understand both the body and the world better, which means that mental imaging is a form of embodied cognition. Sensorimotor activity that comes from an organism's actual movements affects its thinking (Houston, 2024).

In the opinion of Li and Liang (2024), the idea behind embodied cognition is that the human body, mind, and environment are always interconnecting, and that this dynamic interaction is the source of knowledge, rather than relying just on abstract mental processing. Physical sensations impact mental, emotional, and social comprehension as part of the mind-body-environment triad. This perspective aligns with traditional theories within the field of Chinese dance education, particularly Confucian epistemology, which highlights the need to integrate the body and the intellect. Physical activity improves cognitive flexibility and creativity. While most Western-based assessments focus on visual-motor skills, they pay little attention to emotional intelligence, embodiment, and culturally relevant physical awareness in China. It has been seen that cultural factors significantly impact how individuals understand, express, and make sense of their physiological experiences (Li & Liang, 2024). Moreover, Lindberg et al. (2023) stated that dancers often assert that they engage in cognitive processing through the body, seeing it as a universal instrument for thought. The abilities of dancers rely on several cognitive functions, particularly memory processes that facilitate the acquisition, adaptation, modification, re-enactment, and improvisation of intricate dance movement sequences. Chinese students demonstrate that cognitive tendencies are influenced by collectivist beliefs, artistic studies, and moral training. A culturally appropriate physical cognition scale can measure the impact of Chinese dance students integrating their body, emotions, and surroundings in academic and social life (Lindberg et al., 2023).

According to Johnson and Lakoff (1980), a basic component of the human mind, metaphor is more than merely a language construct. They suggested that physiological and sensory experiences helped individuals process abstract ideas. Spatial or physical metaphors were used to conceptualise time, emotion, and knowledge. The theory found systematic mappings between a source domain (concrete experience, like movement or location) and a target domain (abstract notions). Embodied experience shaped cognition; these mappings were based on bodily interactions. This theory described how dance teachers employed movement-based metaphors to communicate complicated concepts. Such metaphors made learning more intuitive, meaningful, and embodied by connecting physiological experience to mental comprehension (Johnson & Lakoff, 1980). Additionally, dance teachers use metaphors like flow, balance, grounding, and expansion to explain complicated movement attributes. These analogies show how instructors organise and teach information via embodied experience. Thus, practical knowledge change takes place when instructors repeatedly project physiological experiences onto pedagogical ideas, transforming both their understanding and teaching methods. This is consistent with embodied cognition since it demonstrates that knowledge is dynamically built via movement and perception (Horn & Garner, 2022).

Objectives

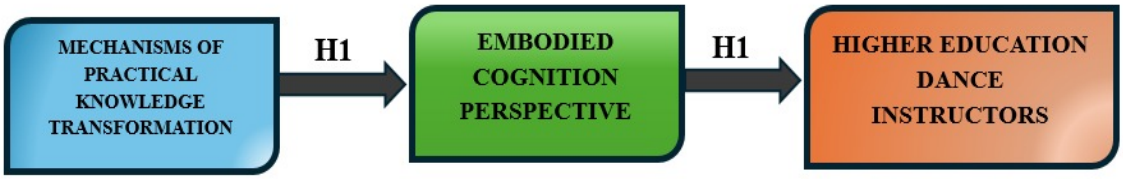
To evaluate the mechanisms of practical knowledge transformation in higher education dance instructors through an embodied cognition perspective.

Methodology

Research Design and Procedure

The primary objective of the study was to examine the processes of transformation of practical knowledge for higher education dance teachers from the viewpoint of embodied cognition. The present study used a qualitative, cross-sectional research approach to investigate. The main data were gathered from Chinese dance teachers of Chinese higher education institutions at a single point in time. Eligible participants were collected from Chinese higher education institutes through interviews. A qualitative method was suitable as it could enable an in-depth analysis of participants lived experiences and perceptions. Credibility, transferability, confirmability, and dependability were used in this study to demonstrate qualitative reliability. The researcher assured that by correctly representing dance teachers' viewpoints on practical knowledge transformation using the embodied cognition approach, the researcher assured credibility. Examining if the results may be used in other contexts, especially in related educational fields, was one way to address transferability. By keeping an audit trail and recording data gathering and theme development, confirmability was guaranteed. Inductive coding and thematic analysis were used to ensure dependability in all professional dance instructors' interview replies. Data were gathered utilising the interview method and thematic analysis, over a specified duration, with the use of an inductive coding method. The study technique would consist of identifying relevant higher education institutions, recruiting people with direct experience of practical knowledge translation from an embodied cognition perspective, conducting interviews and recording replies. It also carefully examined the data to discover recurrent themes connected to practical knowledge translation procedures and to the viewpoint of embodied cognition.

Operational Framework



Subjects or Data Sources

Researchers conducted in-person interviews and employed questionnaires to gather the needed information for the study. The study's data came from professional dance teachers at Chinese higher education institutions. The survey had two sections: (a) questions on the respondents' demographics and (b) questions based on a 5-point Likert scale about the processes of practical knowledge transformation among dance teachers in higher education from an embodied cognition viewpoint. Additionally, interviews were performed using both structured and open-ended questions in order to collect primary data for the research. This made it possible to use qualitative analysis to get better control over the study variables.

Instrumentation and Data Analysis

In order to collect qualitative data, semi-structured interviews were conducted with 267 chosen individuals until saturation of data or until the questions were addressed. Furthermore, the researcher used thematic analysis to examine the data collected. In this technique, the underlying patterns were utilised to categorise the data from the gathered interviews. The researcher also used an inductive coding technique to categorise the data

into topics. Simplified representations of data enabled the extraction of generalisable information about the research setting from the interviewees' experiences and knowledge.

Limitations

As a result of the study's small sample size, its results may not apply to a broader demographic or geographic area. This is one of the limits of qualitative research. Because the interviewer's point of view could impact data collecting and interpretation, subjectivity and bias were potential concerns. In addition, it may be difficult to consistently reproduce the same findings when using semi-structured interviews due to the fluid and unstructured nature of the data-gathering process. Finally, the results may not be very objective as they are dependent on subjective interpretations rather than hard quantitative measurements; this makes it difficult to draw broad conclusions from the research.

Analysis

Research that does not rely on numerical data but instead looks at emotion, experiences, perspectives, and social processes is an example of qualitative analysis. There is a complete disregard for statistical analysis and correlations while doing qualitative research. Instead, this method seeks to explain people's inner workings and the reasons behind their actions. It is often used in studies related to social sciences, education, psychology and health research, where human experiences and circumstances are the most critical component of the analysis. In qualitative research, the data collection is done by interviews, focus group discussions, open-ended survey answers, and document or content analysis. The researchers analyse the data in depth for patterns, themes and interpretations that really represent the views and experiences of the participants. This is often coding of data, putting together thoughts that are related to each other, and theme development, which helps to characterise the issue being researched.

Qualitative research analysis was perfectly suitable for this research topic. Because the focus of the study was solely dependent on individual experience, bodily awareness, and contextual teaching methods. None of these factors could be properly evaluated through numerical data alone. The focus of embodied cognition was on the way the body, emotions, and physical interactions affect learning and understanding. Movement practices, critical reflection, and teachers' experiences were crucial knowledge in dance education. These processes were hard to measure since they are ever-changing and unique for each person. Qualitative research techniques, including interviews, were used to understand how teachers process and make sense of their own teaching experiences. Additionally, the research sought to understand how practical knowledge emerges instead of evaluating results. These processes might be examined in detail using qualitative analysis to find patterns, themes, and meanings in participants' answers. Dance also requires tacit knowledge, such as embodied abilities and understandings. Qualitative methods revealed latent knowledge through an interpretative analysis and comprehensive descriptions. Thus, qualitative research was employed to interview 267 dance teachers about the transformation of practical knowledge within an embodied cognition framework.

Table 1. Interview Questions (Open-ended)

Questions
1) How do dance instructors understand the concept of practical knowledge in the context of the dance teaching practice?
2) Can teachers of Chinese Higher Education Institutions describe how their personal bodily experiences influence the way they teach dance to their students?
3) In what ways do dance teachers transform their own dance experiences into teachable knowledge during classroom instruction?
4) How do dance instructors incorporate students' physical and emotional responses into their dance teaching process?
5) Can dance teachers of Chinese Higher Education Institutions share an example of a dance teaching moment where embodied understanding significantly constructed their instructional approach?
6) What role does reflection (on body movement, performance, or teaching) play in developing practical teaching knowledge?
7) How do cultural traditions and practices in Chinese dance form influence the methods of knowledge transformation?
8) What challenges do dance teachers face when translating their embodied knowledge into demonstrable instruction for dance students?
9) How do interactions with students, colleagues, or institutional expectations shape the teaching process and practical knowledge?
10) In the experience of teachers of dance institutions, how does continuous practice and performance contribute to the evolution of teaching knowledge and skills?

Table 2. Thematic Coding

Keywords	Description	Themes
Spatial orientation, Rhythm	Emphasises how dance instructors use their bodily experiences and sensory impressions in teaching dance	Embodied Cognition in Teaching
Body Movement, Position		
Demonstration, Explanation,	Describes how dance teachers convert personal, experience-based knowledge into study materials.	Practical Knowledge Transformation
Metaphor, Modelling		

Keywords	Description	Themes
Response, Adaptation,	Highlights the function of reflection and interaction with students in shaping teaching practices.	Reflective and Interactive Practice
Collaboration, Self-Assessment		

Theme 1: Embodied Cognition in Teaching

All instructors want their students to learn, regardless of their teaching style. The connection between the mind, body, and environment shapes learning, according to embodied cognition in teaching. It indicates that knowledge is formed by action, body movement, and sensory experience in addition to cognitive processing. To enhance comprehension, educators use live demonstrations and physical encounters. This method is particularly applicable in fields where physical involvement improves learning, such as dance, music, and physical education. Embodied cognition makes information more relevant, experiential, and culturally grounded rather than just theoretical knowledge or passive by combining movement to guide learners in internalising abstract concepts. Dance educators, whether teaching or performing, utilise emotional expressiveness to their students' benefit. Additionally, they update the student learning process and engagement by effectively transmitting meaning through bodily expression. A dance educator uses an embodied cognition method while teaching students to dance, urging them to consider the importance of both the brain and the body in the learning process. The emphasis is on the body as a whole, incorporating rhythm, expression, and technique.

Theme 2: Practical Knowledge Transformation

Individuals take part in practical knowledge transformation when they reflect, apply and re-construct their acquired knowledge by practice and adaptation. In teaching, this transformation occurs when instructors mix their individual experiences with those of their learners, as well as feedback and new material. It is shaped by embodied engagement in practice, problem resolution, and ongoing reflection. This allows for more agile, contextual and responsive information, which enables professionals to overcome difficulties at work, find new methods and improve performance. The knowledge transformation procedure helps dance teachers alter both their theoretical and practical knowledge. It encourages them to use their bodies instead of only thinking abstractly to construct, modify, and convey their teaching knowledge. Following the transformation process, interactions with the environment, sensory awareness, and physical movement all play an important part in cognition, which helps dance instructors transform practical knowledge.

Theme 3: Reflective and Interactive Practice

The concept refers to a process involving interrelated skills in the testing and use of information in the planning and implementation of professional action and claims significant improvements in the competence of professional action and resulting client outcomes. Reflective and interactive practice is a dynamic process where professionals actively engage with others to increase knowledge and performance quality while critically examining their activities. Interaction places an emphasis on conversation, working within a team, and criticism in social and professional settings, while reflection is all about

examining past actions, choices, and results for greater understanding. By bridging individual reasoning with collective knowledge building, they facilitate lifelong learning. In the end, it assists people in becoming more analytical and better able to make decisions in complicated, real-world situations. Dance provides a stage for contemplation on personal, societal, and cultural levels. As a result, the body is a mirror for one's experiences. The dance teaching profession may benefit from more introspection and self-reflection by emphasising and challenging members' own thinking, assumptions, values, choices, and how these shape their professional practice. In the dance education sector, interactive practice is a collaborative and responsive process in which learning takes place through interaction between students, dance instructors and the environment.

Findings and Discussion

The research findings indicated that embodied cognition was at the central part of dance instructors' authentic functional proficiency growth in higher educational settings. Dance instructors were seen to acquire and teach dancing aids through the perceptions of their body experiences, physical understanding, and biological movement-oriented education. Rather than indefinite or immaculately theoretical descriptions, dance teachers integrated live interpretations, activity and spatial understanding in their process of education. This was compatible with the theories of embodied cognition, which indicates that learners learn by communicating with their background through their senses. The study also determined that these procedures made dance students more involved and assisted them in comprehending more since they could associate mentally and physically with what they learned. Further, the research indicated that contemplative and participatory approaches were advantageous in the evolution of educational expertise. Educators often assessed their teaching knowledge, incorporated feedback into their instructional tactics, and transformed their techniques according to student input. This iterative procedure of reflection and transformation assisted in translating implied, experience-oriented understanding into standardised learning methods. This procedure was also demonstrated to be favourably influenced by emotional engagement and cultural setting, notably in the domain of dance, where expression and tradition were essential. Similarly, instructors were competent to better communicate complex embodied details by utilising metaphors and a recommended approach. In conclusion, the results indicated that the modification of functional knowledge was a spirited and continued interplay between educational approach, consideration, and knowledge.

The findings of the qualitative thematic analysis indicated that the process of practical knowledge transformation among dance instructors in higher education is based on embodied experience learning. Participants said that including bodily movement and sensory awareness in the learning process assisted dance instructors in internalising and reinterpreting subjects. Reflective practice emerged as an essential tool as educators continuously evaluated their own effectiveness and individual decisions to broaden their knowledge. Additionally, teachers had to modify their comprehension based on the responses of their students, cultural considerations, and the physical and virtual settings in which they were instructing. This illustrates how dancers' interactions with their social and physical environments shaped their contextual and dynamic cognitive processes.

Additionally, the findings showed that the transformation process was important to emotional involvement and tacit knowledge. With enough repetition, teachers said, one may internalise skills to the point where they become so intuitive one can't describe them, freeing up more brain room for creative expression. Researchers found that enhancing the

relationship to movement boosted the effectiveness of both teaching and learning. Emotional and affective components such as enthusiasm, empathy and self-assurance were key. A pedagogical adaptation was also cited as a significant outcome of the study. This was when instructors employed devices such as guided practice, metaphor and example to make their embodied knowledge more accessible to their pupils. The combination of physical experience, reflection and teaching practice was considered an intrinsic aspect of the ongoing and cyclical process of the development of practical knowledge.

Conclusion

This research explored the real knowledge transformation of dance instructors from the perspective of embodied cognition. The findings indicated that altering information was not merely an academic, abstract process but was intimately related to sensory engagement, bodily movement and physiological awareness. Dance instructors utilise their physical movements and living conditions to comprehend, use and teach knowledge. This demonstrated how dance education is taught, mind and body intricately intertwined. Important things that helped with this shift were reflective practice, creativity, and learning through experience. Teachers responded to what students said and showed feedback, which changed how they taught and made the learning process more interesting. Also, the results showed that cultural and institutional factors affected how embedded knowledge was created and shared, especially when it came to teaching dance in higher education settings. The study's core notion was that embodied cognition provided a comprehensive framework for considering how actual knowledge evolved throughout dance instruction. It highlighted the need to combine physical activity and intellectual thinking in educational techniques. The findings suggested that increasing people's awareness of physical processes might help instructors perform better and make learning more effective. Thus, the study explored the way transformation of practical understanding helped dance teachers to grow professionally and modify their teaching process.

The research may directly help dance instructors from higher education institutions by demonstrating the way body awareness, planned practice method, and practical learning enrich teachers' performance. This may guide them to enhance their teaching process and body-based information into effective teachings. Furthermore, new techniques of teaching dance that stress executed practice more may be helpful for novice dance learners. Because of this, students may fully understand the art, improve their performance skills, and actively take part in dance as a mental and physical cognitive discipline. The research may assist curriculum designers in developing dance programs that are more practice-based and cover a wider variety of themes. By incorporating embodied cognition into lesson preparation, teachers may create classrooms that help students develop in the dance sector. The research also adds to academics in dance education, cognitive science, and pedagogy by contributing to the theoretical understanding of embodied cognition and knowledge transformation. The findings will finally enable arts education authorities and professional training programs to improve teacher training models and educational policies that recognise the importance of applied knowledge instead of theoretical understanding in the learning process. The research will overall contribute to updating teaching practices, learning methods, and the vast development of dance education in higher education sectors.

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Research on the Current State of Pickleball Teaching in Chinese Universities

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Abstract

Pickleball has been increasingly popular in China with its cost-effectiveness and accessibility. The training-oriented framework of pickleball sport remains in its infancy. The authority of Chinese universities encountered difficulties related to curriculum design and institutional support despite their increasing significance in university physical education programmes. Therefore, this study aimed to analyse the function of the current state of pickleball teaching on outcomes of pickleball teaching in Chinese universities. A quantitative and cross-sectional research methodology was applied to collect data from 500 undergraduate students from Chinese universities. This study implemented purposive sampling and descriptive analysis to evaluate basic data. The relationship between pickleball teaching and the outcomes of this teaching process was examined by Analysis of Variance (ANOVA). The findings indicated that advanced and well-coordinated pickleball teaching methods significantly enhanced students' engagement and skill development to improve their physical health of students. Therefore, the study emphasised that the pickleball sports potentially be evaluated for the physical education curriculum, even if it was in its early stages. In conclusion, the research indicated that pickleball encourages students to keep up a healthy lifestyle and increase their sense of community involvement in Chinese universities.

Keywords: Educational Outcomes, Funding, Infrastructure, Pickleball, Teaching Methods

Introduction

Pickleball, a new paddle sport, blends components of table tennis and badminton. Pickleball has quickly grown in popularity in China with government initiatives to support physical fitness and healthy lives. Beginners and students have found this sport particularly intriguing due to its accessibility, safety, and emphasis on social interaction. Pickleball has progressed throughout the nation because of the expanding impact of digital media, which has raised awareness of lesser-known sports. Pickleball has the potential to become a significant part of physical education in academic institutions with the rise of training facilities. People have gradually learned about a variety of new ball sports through newspapers and other media due to the expansion of internet media in recent years (Apriyanti & Gusdernawati, 2023). A study by Stroesser et al. (2024) revealed that Taiwanese people are still unfamiliar with the pickleball game, despite this game being promoted and increasing its visibility in Taiwan through the expansion of internet-based communication. Pickleball has been included in formal education in China, which has presented institutional and pedagogical problems. Despite the sport's social and engaging

aspects drawing attention of many students, the educational framework of this sport remains inadequate, and requires improved management as well as long-term planning. However, the lack of organised curricula and suitable teaching materials continues to limit pickleball education's advancement at the university level (Stroesser et al., 2024). On the other hand, pickleball is a relatively new activity with fewer players than other popular sports. Some students want to participate in the pickleball sport to revitalise the pickleball community. The positive perceptions or emotions students get from engaging in leisure activities are referred to as leisure satisfaction. This refers to how satisfied people are with their overall leisure experience and context, which is derived from the fulfilment of their perceived or unperceived needs.

The sport's inclusive and inspiring qualities continue to increase student involvement, but its efficacy is constrained by a disorganised teaching structure. Research by Wang et al. (2023) emphasised that pickleball is currently being promoted through optional classes and campus organisations as part of larger physical education changes and national fitness goals. Many games are played on modified tennis or badminton courts rather than special facilities because infrastructure is still in its infancy. The pickleball sport is ideal for academic environments because of its easy adaptability and compatibility for players of all skill levels. The growth of pickleball sport is also being aided by structured development strategies and growing institutional support, such as efforts to formalise competitions and bolster its presence in higher education (Wang et al., 2023). Players of the pickleball sport have derived satisfaction from the sport's social, psychological, and physical advantages despite pickleball's low field constraints and ease of play. Research by Li (2025) demonstrated that the concept of well-being is complex and includes both cognitive and emotional elements. Pickleball players experience a variety of subjective personal sentiments that influence their emotions or outlook on life. Therefore, the event planners use appropriate strategies to promote pickleball participation among the university students of China. For instance, the venue may offer equipment introduction and sales services to increase student access to appropriate equipment. Additionally, a unique fan page can be created by the organiser to disseminate information about the event and educational materials, or it can simply serve as a forum for pickleball friends to interact (Li, 2025). These policies and initiatives could guarantee that everyone who wants to play pickleball has the chance to do so, to enhance their leisure time and overall well-being.

Review of Related Literature

People have gradually heard about a variety of new ball sports through newspapers and other media due to the growth of online media in recent years. In the period of the internet's growth, Chinese students are still unfamiliar with pickleball, which has been gradually pushed in China. According to an assessment of pertinent research, pickleball primarily addressed the problem of senior pickleball participation. Prior research by Wang et al. (2023) indicated that most pickleball teaching methods in Chinese universities applied interactive and curriculum-based methods. These procedures have been shown to support students in acquiring new skills and increasing their involvement in the athletics of universities. Additionally, the study has shown that pickleball employment and engagement greatly enhance students' psychological health and quality of life. This academic procedure strongly highlighted gradual skill growth, the combination of theoretical and practical knowledge, and active participation among students. Their study helped Chinese universities implement competency development and student motivation-oriented teaching strategies. Research also demonstrated the positive results of these instructional strategies (Wang et al., 2023). Conversely, research

by Terrell and Ficquette (2023) on pickleball training methods emphasised the importance of including agility exercises with game-like situations. The researchers underlined that pickleball requires moderate endurance and fast side-to-side motions. Additionally, they determined that pickleball is a crucial sport for creating movement-specific training as opposed to only adhering to conventional fitness routines. The study also evaluated the importance of implementing injury prevention techniques (Terrell & Ficquette, 2023).

The previous research on pickleball infrastructure at universities revealed that the growth of pickleball sports has encouraged universities to build flexible, expandable buildings. The research found that pickleball does not need a lot of infrastructure, such as large courts or permanent netting. This indicated that institutions do not require a lot of financial help to modify already-existing facilities, such as outdoor pickleball courts and badminton courts. Additionally, according to this study, the pickleball courts are inexpensive and very sturdy (Apriyanti & Gusdernawati, 2023). However, research by Lauxtermann and Stubbs (2025) indicated the benefits of universities from well-structured infrastructure and the demands of pickleball sports. The research emphasised the better requirements of financial support for resources and more efficient collaboration in Chinese universities to enhance the development and implementation of pickleball sport. The study also demonstrated that official funding for pickleball sports in China is often determined by the number of players and facilities provided (Lauxtermann & Stubbs, 2025).

According to Social Learning Theory, people pick up new behaviours and viewpoints by seeing and copying the activities of others in social situations. Additionally, the theory emphasised that reinforcement and feedback significantly affected the key roles of methods such as motivation, reproduction, and attention (Bandura & Walters, 1977). According to recent research, sports education methods at Chinese universities raise students' motivation and behavioural engagement to the level of teacher-centred approaches. Peer relationships and instructor assistance raise involvement and self-efficacy. These findings are consistent with the Social Learning Theory, which holds that students increase their knowledge through social interaction, imitation, and observation (Liu et al., 2024). Henceforth, Social Learning Theory delivered a relevant theoretical basis to comprehend the connection between the current state of pickleball teaching and the outcomes of pickleball teaching in Chinese universities, as social interaction and peer support influence the interest and participation of students.

Objectives

To identify the impact of the current state of pickleball teaching on outcomes of pickleball teaching in Chinese universities.

Methodology

Research Design and Procedure

A quantitative and cross-sectional research design was employed in the current study to examine the role of the current state of the pickleball teaching approach on the outcomes of pickleball teaching in Chinese universities. The design was enabled to gather data from undergraduate students at Chinese universities who were enrolled in pickleball sports at a certain time. A structured questionnaire was circulated to the suitable respondents through online as well as offline channels to accomplish the data collection process. The survey instrument was developed using the selected variables in this study. A pilot test was used

to ensure the validity of the data, while Cronbach's Alpha was applied to ensure the proper reliability. Furthermore, the administration of the questionnaire to the chosen sample helped to determine the measurable relationship between the current state of pickleball teaching and the outcomes of pickleball teaching. The confidence interval is 95%, which utilises the direction and size of the statistical link. A p-value < 0.05 was set for statistical significance. The researcher also applied descriptive analysis to determine the key elements of this study.

Operational Framework

Subjects or Data Sources

A survey was conducted to gather primary data for this analysis of the study. Students from Chinese universities provided the collected data for this study. The survey was split into two sections: (a) the personal information of the respondents and (b) a 5-point Likert scale with enquiries about the impact of pickleball teaching on Chinese universities.

Instrumentation and Data Analysis

The purposive sampling was utilised to select valid and reliable study participants in this research context. The Rao Soft tool suggested 459 study participants for the data collection of the study. Therefore, 650 survey questions were provided to the respondents. Researchers received 610 questionnaires; 110 were rejected because of unwanted and unprofessional information. Consequently, the final sample size was 500. Microsoft Excel, along with SPSS 25 were used for statistical analysis of the study. The researcher applied a descriptive analysis technique to comprehend the important elements of the collected data, further employing the ANOVA to evaluate the relationship between research variables.

Limitations

The research study faced several limitations inherent in quantitative research. The use of closed-ended survey questions limited the capacity of participants to provide in-depth information, which made it more difficult to understand complex viewpoints or contextual elements. This limitation also affected their assessments of the state of pickleball instruction in Chinese universities. The impact of pickleball instruction in Chinese colleges was oversimplified by quantitative data. Moreover, the findings of the research topics were represented, as collecting data solely from Chinese universities led to issues related to the limited broader applicability of this study to other educational contexts. The cross-sectional design restricted the study's ability to demonstrate causality because the data would capture relationships at a single point in time. Finally, the results could not be entirely generalisable outside of the sampled community, as the collected data will be influenced by the demographics and interest in pickleball of the respondents.

Analysis

Factor Analysis

The factor analysis (FA) goal is to find hidden patterns in otherwise available data. The goal of the simulation is to identify infractions and possible relationships that are apparent to the

unaided eye. The "Kaiser-Meyer-Olkin (KMO) Test" is used to calculate sampling adequacy to define an appropriate value for FA. It has been demonstrated that the mathematical model and related variables used for sampling produce accurate results. The data may contain duplicates. The information is more visible with lower values. KMO assigns the investigator a number between 0 and 1 in this study. The sample population was accepted with a KMO value between 0.8 and 1.
Kaiser indicated that the following standards have been considered appropriate parameters:
Kaiser needs to fulfil the following certification prerequisites:
Middle grades normally range between 0.70 to 0.79; a pitiful range is 0.050 to 0.059; far below the usual range of 0.60 to 0.69.
A quality point rating between 0.80 to 0.89. The range of 0.90 to 1.00 astounds them.
Table 1: Examination of KMO and Bartlett's Sampling Adequacy
The KMO scale value: 0.887
The approximate Chi-Square value: 4651.167.
190 is degrees of freedom (df); sig. = 0.000.

Table 1: KMO and Bartlett's Test

KMO and Bartleett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		*0.887*
Bartleett's Test of Sphericity	Approx.Chi-Square	4651.167
	df	190
	Sig.	0.000

"Bartlett's Test of Sphericity" was used by the researchers to assess the statistical significance of the correlation matrices. If the KMO value was 0.887, the sample size was deemed adequate. Bartlett's Test of Sphericity provided the researcher with a P-value of 0.00. Consequently, a significant test result using Bartlett's Test of Sphericity indicates that the correlation matrix is not a correlation matrix.

Independent Variable

Current State of Pickleball Teaching

Pickleball is a paddle sport that combines the components of badminton, tennis and other racket sports. Pickleball is a fast-paced indoor and outdoor game that can be played on a court which is badminton-sized with short-handled paddles and a perforated hollow plastic ball over a low net. This sport can be played with two pairs of players or two opposing players. The structure and pedagogical methods applied to instruct university students of China in a professional and educational context are defined as the current state of pickleball teaching. This teaching method of this sport is a blend of traditional and modern coaching techniques that emphasise player engagement and skill development (Kellas et al., 2025). The teaching process of the pickleball sport has been rapidly developed through digital tools and performance-based video analysis. The pickleball teaching method is not only based on the fundamental skills, but it is also dependent on strategic thinking and game awareness. The structured lesson plans and assessment frameworks support pickleball being incorporated into the physical education curriculum in universities. In addition, the current state of pickleball teaching is accommodated to various age groups and skill levels to make the ball game more attainable to beginners and advanced players. Overall, the pickleball

teaching method reflects the adaptive and professionalised approach to its rising university students (Turan, 2024).

Dependent Variable

Outcomes of pickleball teaching in Chinese universities

The outcomes of pickleball teaching indicate a positive impact on educational and social dimensions in Chinese universities. Participation in pickleball classes improves students' physical fitness and hand-eye coordination. It is especially effective in encouraging consistent participation of students with varying fitness levels. Pickleball also develops self-confidence and emotional well-being among the students at universities in China. The enjoyable nature of the pickleball sport helps students to relieve their academic pressure, along with a positive attitude toward their physical activity. Moreover, pickleball teaching increases students' motivation in sports. It helps to improve lifelong exercise habits, aligning with fitness awareness and public health with wider national goals (Ryu et al., 2022). The inclusion of pickleball sports in Chinese universities introduces a modern and versatile sport that combines the characteristics of additional racket games through physical education programmes. Pickleball also fosters teamwork and cooperation among Chinese students, as it encourages interaction and peer monitoring. However, the outcomes of pickleball teaching methods face some challenges in Chinese universities. These challenges include the limited availability of instructors and insufficient infrastructure. Additionally, the pickleball in the educational system is in an early stage, resulting in inappropriate teaching quality and program arrangements. Finally, although the pickleball teaching process benefits the Chinese university students, its long-term effect depends on the modern professional training system and improved curriculum development (Weidong et al., 2026).

Relationship between the current state of pickleball teaching and outcomes of pickleball teaching in Chinese universities

The current situation of pickleball teaching has improved in teaching practices to influence the outcomes of students. The pickleball teaching in China is developing by increasing popularity and adopting modern technologies in teaching methods for students. However, the pickleball sport is also facing some challenges, such as insufficient training approaches and standardised teaching elements. The standard teaching method significantly influences the outcomes of students in Chinese universities. For instance, if the teaching method is well-structured and interactive, the students become better in physical fitness and improved coordination with others. Research demonstrated that participation in pickleball sport enhances students' psychological and physical well-being, as the sports represent the enjoyable and innovative learning environment (Zhou, 2026). In addition, teaching quality influences the motivation to participate, and well-organised instruction structure helps to increase the interest among students. Conversely, the limitations of the pickleball teaching method restrict the positive outcomes of pickleball teaching in Chinese universities. Some research also indicates that insufficient curriculum design and improper instruction reduce students’ engagement and interest in learning. The lack of systematic teaching frameworks reduces the realisation of the benefits of pickleball education (Qian, 2024). Finally, the current state of teaching methods determines the positive outcomes to represent the development and institutionalisation of pickleball programs. Therefore, improving the teaching strategies and institutional support will play an important role in developing the physical and psychological benefits among the students in Chinese universities.

Based on the discussion, a hypothesis is developed by the researcher to identify the important connection between the current state of pickleball teaching and outcomes of pickleball teaching in Chinese universities.

"H_{01}: There is no significant relationship between the current state of pickleball teaching and outcomes of pickleball teaching in Chinese universities."
"H_1: There is a significant relationship between the current state of pickleball teaching and outcomes of pickleball teaching in Chinese universities."

Table 2: H_1 ANOVA Test

ANOVA					
SUM					
	Sum of Squares	**df**	**Mean Square**	**F**	**Sig**
Between groups	86,647.934	170	8990.021	1311.646	0.000
Within Groups	738.498	329	6.854		
Total	87,386.432	499			

This study has represented significant outcomes. With a distinct F-value of 1311.646 and a distinct p-value of 0.000, researchers can determine that the statistical significance is considered if the value is below the 0.05 alpha level. The findings of the study emphasised that the null hypothesis was rejected, while the alternative hypothesis, "**H1: There is a significant relationship between the current state of pickleball teaching and the outcomes of pickleball teaching in Chinese universities**," was accepted.

Findings and Discussion

The discussion emphasised that the current state of pickleball teaching significantly impacted the outcomes of pickleball teaching in Chinese universities. The findings indicated that a well-structured teaching method and a knowledgeable instructor increase the students' interest in learning new sports and improve physical fitness. It was observed that the implementation of modern game-oriented strategies and skill-based training motivates students in participation and enhances physical fitness programmes. The outcomes of the study indicated that an enjoyable sports environment develops psychological well-being and self-efficacy among students. Moreover, the study elaborated that the pickleball teaching developed the social skills of students, such as teamwork and communication skills with other participants. The study results emphasised that students who actively participated in the pickleball sport reduced their academic stress and developed more physical activity with positive thoughts. This study evaluated that the pickleball sport is not only beneficial for physical fitness, but it also increases emotional and social skills among students in a Chinese university. However, the discussion underscored the lack of trained instructors, and the absence of proper elements has restricted the potential of the outcomes of pickleball teaching. This limitation affected the consistency of teaching quality and the arrangements of pickleball programs. Moreover, support of institutions and integration at the policy level remained insufficient because of the developmental stage of pickleball sport. The discussion also indicated that the ANOVA results and statistical analysis ensure the significant interrelationship between the current

state of pickleball teaching and the outcomes of pickleball teaching in Chinese universities, rejecting the null hypothesis. Finally, it can be understood from the discussion that the training strategies and appropriate infrastructure efficiently increase the development of social and emotional skills in outcomes of pickleball teaching in the Chinese university context.

The results of the research study evaluated that the current state of pickleball teaching efficiently influenced the outcomes of pickleball teaching in universities in China. The findings of the study indicated that the structured and well-built infrastructure positively influenced the development of social and emotional skills and physical fitness of students in Chinese universities. The students who were exposed to interactive and contemporary teaching methods had higher levels of engagement and hand-eye coordination compared to students who received less structured instruction. The findings of the research highlighted that the well-organised infrastructure significantly influenced the efficiency of pickleball instruction. Additionally, pickleball instruction was proven to have a positive impact on university students' psychological development. The students who played pickleball experienced reduced academic stress and improved physical fitness. Students were motivated to actively participate in the pickleball sport because it was trained in an enjoyable and learning environment. The findings also indicated that the teaching of the pickleball sport has improved students' social interactions. The sport promoted teamwork and communication, which helped students develop interpersonal connections. These social advantages demonstrated pickleball's wider educational worth beyond physical well-being. But the findings also demonstrated that several limitations hindered the efficacy of pickleball instruction. The inadequate infrastructure and a lack of curricular integration restricted the continuous delivery of well-structured training. Notwithstanding these limitations, the statistical analysis supported the acceptance of the alternative hypothesis by confirming a substantial correlation between the status of pickleball instruction and its results. Finally, the results highlighted the necessity of better instructional techniques and institutional assistance.

Conclusion

The study concluded that the outcomes of pickleball teaching at Chinese universities were significantly and positively influenced by the current state of the pickleball teaching method. It was discovered that students' physical health and skill development were improved when organised teaching approaches were paired with contemporary instructional tactics and interactive learning infrastructure. According to the study, students who took part in well-run pickleball programs had gains in both their physical and mental health, including less academic stress and more self-assurance. In addition, the results emphasised that teaching pickleball supported students in developing social and emotional skills. The null hypothesis was rejected because of the statistical analysis. The ANOVA results demonstrated a strong and substantial association between the teaching strategies and the outcomes of this study. But the study also indicated several challenges that hindered the efficacy of the pickleball teaching method. These included insufficient institutional and policy support, as well as poor infrastructure. These limitations demonstrated that pickleball's development was still in its early stages and needed more focus, despite the sport's great potential as an important part of university physical education. In conclusion, it can be concluded that institutional support and instructional design quality were critical to pickleball teaching performance. It was determined that enhancing curriculum integration and making infrastructural investments may improve pickleball education's long-term results. The proper training procedure by knowledgeable instructors may also motivate the

students to participate in the pickleball sport. Therefore, the study underlined that if the right policies were put in place, pickleball may play a significant role in encouraging a healthy lifestyle and holistic student development.

This study demonstrated the significant role in contributing to the theoretical and practical advancement of the pickleball teaching method in Chinese universities. The study may improve the body of knowledge on developing sports in higher education by offering empirical data on the connection between instructional strategies and student outcomes. The study may emphasise that well-structured teaching methods and institutional support may significantly improve the way of students' physical, psychological, and social development. The study may be significant for teachers and curriculum designers since it provides information on the way to improve instruction and create successful physical education programs. The results of the study also encouraged policymakers to invest in infrastructure and training to acknowledge pickleball as an important part of the university curriculum. Additionally, the study also promoted lifelong physical activity and student well-being by highlighting the wider educational benefits of incorporating cutting-edge sports into academic settings.

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Research on the Integration of University Dance and Multiple Disciplines Based on Steam Education

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Abstract

The integration of dance education with various academic fields has improved scholarly appreciation for the university within the framework of Science, Technology, Engineering, Arts, and Mathematics (STEAM) education. Currently, the integration of dance with additional academic disciplines in university curricula has remained restricted in many universities. Therefore, the present research aimed to explore STEAM education within the integration of university dance and multiple domains in China. The present research used a quantitative, cross-sectional study design to collect data from 500 students from universities in Shanghai, China. This study also implemented purposive sampling and distributed survey questionnaires to evaluate basic data through descriptive analysis. Analysis of Variance (ANOVA) was employed to explore the relationship between the research variables. The primary research findings highlighted that STEAM education has a significant influence on dance and multiple disciplines of the university in Shanghai, China. The study also elaborated that institutional resource support to students and encouraging academic reflection influenced the integration of dance and multiple disciplines among the Chinese universities. In conclusion, efficient implementations of STEAM education are significant for promoting university dance and multidisciplinary integration. Moreover, inquiry-based learning, developing supports of institutions and creative thinking, along with reflective practice, may be constructive for universities in China.

Keywords: AI-Based Learning, Slow Learners, Virtual Reality (VR), 1C Schools

Introduction

STEAM education's multidisciplinary technique to innovative education that involves science, technology, engineering, arts, and math has garnered notice. Dance as an artistic and expressive profession has enabled creative higher education teaching and learning within this framework. The connection between art and science has significant amount of promise to improve education. Dance as an expressive art form plays a crucial role in aesthetics and culture as well as in integrating science into education to enhance educational content (Li & Chin, 2024). Dancing is more than simply expressing individuality, as it may also be a creative way for learners to develop technical and scientific ideas. This interrelated curricular education is swiftly advancing and increasingly getting incorporated into the educational system with creative technological approaches, including virtual reality (VR) and artificial intelligence (AI). Integrating dance into an interdisciplinary curriculum enhances students' artistic and physical skills while improving their cognitive understanding of technology and science. Therefore, the

merging of arts and sciences improves curricular material. It encourages innovation and fosters analytical skills that assist students' progress to STEAM education (Buono & Burnidge, 2022). Dance allows learners to experience STEAM visions through physical movement. These theoretical lenses establish dance as a creative and intellectual practice with supporting STEAM education's inquiry-based aim. The artistic fields embraced by STEAM can be varied (Wu et al., 2025). Divergent perspectives on the notion of STEAM education primarily originated from STEM, with the varying significance attributed to each of the five fields. STEAM education is an efficacious interdisciplinary method for addressing real-life problems. The change to STEAM ensured the development of different skills in addition to building knowledge. Hence, enhancing the development of students' skills by using active methods in cooperative function and through a learner-centred technique is important (Filipe et al., 2024).

Dance studies in colleges substantially enhance students' professional and personal development. Dance instruction markedly improves students' physical well-being and cultural consciousness. Students view dance learning as advantageous for enhancing self-confidence and expanding professional prospects. The instructors underscored the significance of systematic training and digital resources in contemporary dance instruction. Furthermore, dance programs enhance students' social engagement and underscore the necessity for new teaching methodologies. Dance education in China facilitates growth in multidisciplinary information, cultural interchange, and professional growth, offering a more comprehensive appraisal of its impact (Tan, 2026). Specifically, under STEAM education, higher education has shifted toward transdisciplinary and practice-oriented learning. Art-integrated STEAM encourages innovation, creativity, and critical thinking, which are needed to solve 21st-century global problems. Universities are increasingly recognising dance as a powerful medium for transdisciplinary integration as well as an artistic discipline. Dance as an actual and creative form of wisdom offers a unique opportunity to connect with science, technology, and maths. Adding dance to university classes like physics, biology, technology, and engineering lets students experience abstract theories through movement (Cui et al., 2026). The fast expansion of international finance and technological approaches has made developing transdisciplinary and inventive skills a crucial goal of education in the 21st century. National educational changes in China promote innovation-driven growth and interdisciplinary talent development, which includes dance in STEAM education. The position of dance education in academics helps to develop a well-organised curriculum with creative and analytical skills (Li, 2023). This innovative academic integration uses dance as a dynamic instrument for multidisciplinary exploration, which treats dance beyond a performance art. Elements such as rhythm and coordination are essential to dance education. These elements are closely relevant to concepts in mathematics, engineering and physics. Hence, the integration of dance education in technical and scientific fields helps students to learn and understand practical, complex concepts. Moreover, dance inclusion aligns with contemporary educational paradigms like STEAM in several fields, which underscore the significance of creativity and innovation in conjunction with technical proficiency. Higher education institutions often conduct research-oriented educational programmes through multidisciplinary curricula, collaborative initiatives, and the inclusion of dance. The arts advocate for human-centred perspectives and making learning more meaningful. STEAM education promotes the analysis of concepts such as progress, balance, structure, and design through project-based and practical learning across disciplines. It educates learners for the needs of

current society by integrating technical skills with creativity, promoting innovation, teamwork, and critical thinking (Papadopoulou, 2024).

Review of Related Literature

STEAM education has evolved as a transformative pedagogical paradigm in China, highlighting interdisciplinary integration and innovation. STEAM promotes innovation, objective evaluation, and analytical abilities through integrated educational experiences, enhancing the conventional Science, Technology, Engineering, and Mathematics (STEM) framework. STEAM is a structure that incorporates the arts. Recently enacted educational initiatives like the Education Modernisation 2035 framework have made interdisciplinary curriculum more popular in China (Tian & Kenayathulla, 2026). These improvements aim to boost students' inventiveness and proficiency. A 2025 study in Shanghai on "deep integration teaching" demonstrated that structured interdisciplinary methods can enhance students' practical skills and conceptual understanding without increasing academic pressure. Worldwide, educators endeavour to implement STEAM in education to cultivate talents necessary for the future (Huang et al., 2025). China's Education Modernisation 2035 require 10% of instructional time for transdisciplinary thematic study. The problem has progressed from transient initiatives to attaining profound, sustained curriculum integration that advantages all pupils, particularly under reforms such as China's "Double Reduction" policy (Rafiq-uz-Zaman, 2025).

There has been an increasing amount of research that investigates the incorporation of multidisciplinary approaches into STEAM education in China. In Chinese universities, the innovation of general studies models has demonstrated the significance of support from institutions and curricular design in facilitating multidisciplinary education. STEAM courses with cultural elements boost student engagement, creativity, and practical learning, reinforcing China's value of context-based and culturally appropriate education. In China's STEAM course history, development in general education, academic assignments, and core literacy have been prioritised over higher education, specifically higher vocational education (Li & Li, 2023). Meanwhile, excessive imitation of Western STEAM curricula has resulted in a lack of humanistic viewpoints, inadequate integration with existing courses, and unsustainable development. The progress of STEAM education, matched with exemplary local culture, must consider the prevailing circumstances in China. This methodology has established a novel direction for the local advancement of STEAM education, significantly influencing the cultivation of regionally distinctive talent and the enhancement of China's exceptional local cultural education. The local culture of China serves as a spiritual foundation for its population, integrating the values and principles widely embraced by its domestic individuals. It represents the fundamental philosophy, artistic principles, and aesthetics of the national culture, serving as a source of motivation for innovative expression (Qian et al., 2023).

The most recent research generated from China has specifically investigated dance within STEAM environments. A significant study examined transdisciplinary dance-oriented STEAM education in Shanghai, China. Previous studies indicated that incorporating dance into STEM education improved student engagement, creativity, and collaboration using embodied learning methodologies. Dance basically integrates scientific and mathematical concepts of force, balance and spatial awareness, making it an invaluable resource for interdisciplinary teaching. It underscores the essential function of institutional support, such as adaptable scheduling and educator training in the effective execution and longevity of these projects (Mao et al., 2025). Moreover, current literature

evaluated that although arts integration in STEAM is increasing, dance is still comparatively under-represented relative to other creative forms such as visual arts and music. According to the researcher, interdisciplinary dance programs at Chinese universities are still developing and generally limited by a lack of institutional resources and curricular frameworks (Milara & Orduña, 2024).

Howard Gardner's Theory of Multiple Intelligences explained the standard comprehension of learning beyond visual and auditory methods. The researcher claimed that people generally have different types of intelligence instead of a single general ability (Gardner, 1983). The theory provided a strong framework which supported the integration of dance education with STEAM disciplines for university students. When STEAM education is combined with dance, it acts as an interdisciplinary medium to connect artistic expression and scientific ideas. This integration fosters practical learning to develop creativity, critical thinking skills and teamwork among university students (Li & Chin, 2024). Hence, the integration of dance into STEAM education encourages more effective learning and teaching methods across various domains.

Objectives

Research Objective

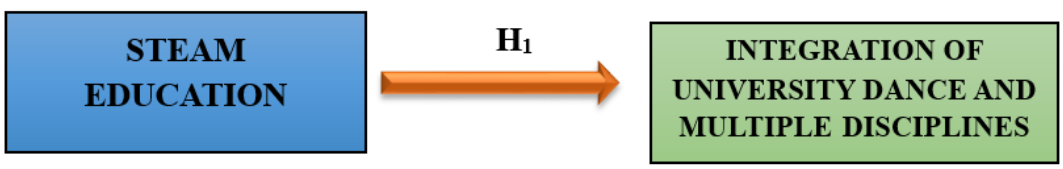
To examine the impact of STEAM education on the integration of university dance and multiple disciplines.

Methodology

Research Design and Procedure

This current research used a quantitative, cross-sectional study design to examine university-level dance and multi-subject integration based on STEAM education in universities in Shanghai, China. The research employed quantitative data to analyse trends and evaluate correlations among study variables. This study examined dance and STEAM pupils' viewpoints, learning experiences and teaching strategy. The researcher used purposive sampling to select students who were enrolled in both Dance and STEAM disciplines. The Likert-scale questionnaire included interdisciplinary learning, creative growth, technological integration, and motivation for dance education. The study survey instrument was prepared based on the criteria. The researcher performed a pilot study to ensure validity, whereas Cronbach's alpha was employed to estimate reliability. Additionally, the selected samples completed a questionnaire and SPSS version 25 was used to uncover measurable relationships between STEAM-based university dance integration and related outcomes. The confidence interval at 95% was employed to indicate the direction and size of the statistical connection. Descriptive analysis identified the key features of the data, and ANOVA examined the relationship between the variables.

Operational Framework



Subjects or Data Sources

This study used a survey to obtain primary data from dance students at Shanghai Universities. Participants were selected from STEAM universities. Students with dance and STEAM education were randomly selected. Students' perspectives, experiences in learning, and involvement in interdisciplinary dance courses were the main data sources collected via structured questionnaires. To supplement the research, course outlines and program descriptions on interdisciplinary or STEAM-based dance instruction were studied. These sources provided quantitative data to analyse STEAM-based interdisciplinary integration in dance programs at the Universities in Shanghai, China. There were two parts to the survey: (a) information on the respondents' demographics, and (b) a 5-point Likert scale with quiries about the integration of university dance and multiple disciplines based on STEAM education.

Instrumentation and Data Analysis

The present research used a purposive sampling technique to select valid and relevant study respondents in the research context. Raosoft tool recommended 384 research participants for the data collection for the study. Therefore, 565 survey questionnaires were distributed to the respondents. 535 questionnaires were returned to the researchers, from which 35 questionnaires were discarded because of inappropriate or incomplete responses. Henceforth, the final sample size was 500. Microsoft Excel as well as SPSS version 25 were employed for performing statistical analysis for the research study. The researcher employed a descriptive analysis technique to possess the key elements of the collected data, while ANOVA was used to assist in evaluating the data collected.

Limitations

The quantitative research had several limitations which might have affected the conclusion of the study. As the research was only conducted in Shanghai, it limited the application of the results to other regions of China or other parts of the world. Hence, this caused the generalisability of the findings. Moreover, the use of closed-ended survey questions prevented the responders from offering in-depth clarifications. Moreover, the cross-sectional research design restricted the potential to accurately capture the changes in students' opinions and learning experiences. Additionally, the study had a small sample size, which limited the findings from being wider and more comprehensive. Ultimately, the results would not be generalisable beyond the selected population, as there are variabilities in demographic characteristics and educational exposure patterns of the respondents of the study

Analysis

Factor Analysis

The primary goal of Factor Analysis (FA) is to indicate the influencing element structure of a collection of measurement components. It is recognised that latent elements influence the scores of the identified variables. The preliminary objective of this work is to establish pathways of causality between latent causes, measurement inaccuracies, and visible phenomena. The Kaiser-Meyer-Olkin (KMO) test is employed to decide if the gathered information is adequate for FA. It has been shown that the individual model and its associated variables' sampling adequacy are evaluated. The existence of duplicates might be uncovered by the data.

With the goal to aid the investigator, KMO gives them a number between 0 and 1. A KMO value, which lies between 0.8 and 1, defines an appropriate sample population.

According to Kaiser, the following have been considered the parameters that are suitable: Kaiser has the following certification requirements:

- An appalling 0.50 to 0.59; well below the usual range of 0.60 to 0.69; The typical range for middle grades is between 0.70 and 0.79.
- A quality point score between 0.80 and 0.89. The interval from 0.90 to 1.00 astounds them.

Table 1: Examination of KMO and Bartlett's Sampling Adequacy
According to the KMO scale: 0.895.
The approximate Chi-Square value: 4580.258.
190 is degrees of freedom (df); sig = 0.000.

Table 1. KMO and Bartlett's Test.

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin (KMO)		0.895
Bartlett's Test of Sphericity	approximate Chi-Square value:	4580.258
	df	190
	Sig.	0.000

The researchers used Bartlett's Sphericity Test to identify the comprehensive significance of the correlation matrices. The KMO score was 0.895, which indicated the sampling adequacy. Based on Bartlett's Sphericity Test, the p-value was 0.00. A significant outcome from Bartlett's Sphericity Test indicated that the correlation matrix was not an identity matrix.

Independent Variable
STEAM education:
STEAM education involves the arts disciplines into the syllabus and education of Science, Technology, Engineering, and Mathematics. This method is identified as beneficial for producing fresh educational possibilities that prioritise practical design and objective evaluation expertise. This education methods boost the utilisation of creativity along with objective evaluation and analytical skills in learners to investigate real-life situations. Moreover, STEAM activities underscore cooperative learning and the enjoyment of learning. Technology encompasses not only the utilisation of advanced technology like computers and robots but also the integration of arts and crafts to create fresh solutions. A STEAM assignment typically provides a harmonious combination of modern and traditional methodologies (Leavy et al., 2023). Academic establishments are increasingly enforcing STEAM education methods to prepare learners for rapidly transforming advanced societies and various employment opportunities. STEAM education is a framework that integrates scientific and technical knowledge with creative practices to cultivate creativity and problem-solving. This methodology equips students to tackle intricate global issues by cultivating technical proficiency and innovative thinking abilities (Segarra-Morales et al., 2026).

Dependent Variable
Integration of university dance and multiple disciplines
University dance integration is an interdisciplinary approach to education that combines dance with academic fields to offer a comprehensive and advanced learning environment. It converts dance from a strictly artistic topic into a multidisciplinary area that fosters creativity, comprehension and the application of practical knowledge by combining

disciplines like science, technology, engineering, humanities, social sciences and mathematics (Li & Chin, 2024). The idea is rooted in interdisciplinary learning, which integrates approaches, ideas and practices from various fields to improve educational results and address complicated challenges. Interdisciplinary integration authorises greater collaboration and production of concepts. Dance integration in university education encourages experiential and project-based education by engaging students in real-world situations. Digital technology may be related to dance via multimedia performance and VR applications. It can further draw on psychology, cultural studies, sociology and history to examine emotional expression, communication and cultural relevance. It is an integrated strategy that promotes analytical skills, creativity, teamwork and strategic planning skills that are important in both creative and professional contexts (Yu et al., 2025).

Relationship between STEAM education and integration of university dance and multiple disciplines

The relation between STEAM education and the incorporation of other disciplines with dance at the university level is deeply interconnected, as both emphasise interdisciplinary instruction, creativity, and practical problem-solving in higher education institutions. STEAM education creates a conceptual and practical foundation for integrating dance with other academic fields. Higher education STEAM supports the integration of scientific and technological knowledge with creative practice, where dance is a performing art and a means for cognitive, analytical, and innovative learning. A recent study suggests that the objective of STEAM techniques in universities is to provide learners with transdisciplinary competencies, foster intellectual curiosity, and encourage collaborative solutions to complex global challenges. This is in good agreement with the introduction of dance in the university, a place where students encounter a range of disciplines, including physics, psychology, digital technology and cultural studies, via learning through movement (Huang et al., 2025). The incorporation of dance into the STEAM framework enhances both intellectual and artistic abilities. Previous studies demonstrate that the amalgamation of dance and technological principles significantly improves learners' innovation, analytical abilities, and scientific literacy, highlighting the significance of interdisciplinary educational methods. In this context, dance serves as a medium bridging the abstract notions of science and the concrete experience of understanding. For instance, dance can physically explore subjects such as movement, balance, and force, enabling students to cultivate a more intuitive comprehension of complex concepts. This underscores the primary aim of STEAM education in amalgamating information from several disciplines to provide pertinent and engaging learning experiences. STEAM-based integration promotes the incorporation of digital media, VR, and AI in dance education. These technologies are employed in multidisciplinary dance programs to enhance creativity and education. In STEAM education, combining dance with STEM subjects allows for a more adaptable, inclusive, and creative university experience by promoting creativity and new knowledge systems (Tan, 2026).

According to the discussion, the involved researchers have developed the mentioned hypothesis to investigate the meaningful connection between STEAM education and the integration of university dance and multiple disciplines:

"H01: There is no significant relationship between STEAM Education and integration of university dance and multiple disciplines."

"H1: There is a significant relationship between STEAM Education and integration of university dance and multiple disciplines."

Table 2. H1 ANOVA Test.

ANOVA					
Sum					
	Sum of Squares	df	Mean Square	F	Sig.
Between groups	85,896.598	195	8713.752	1154.598	0.000
With in groups	897.859	304	7.547		
Total	86,794.457	499			

Meaningful results have been drawn from this investigation. With a distinct F-value of 1154.598 and a separate p-value of 0.000, researchers can determine that the statistical importance is less than the 0.05 alpha level. The findings indicate that the alternative hypothesis, "H1: There is a significant relationship between STEAM Education and integration of university dance and multiple disciplines", was accepted, and the null hypothesis was rejected.

Findings & Discussion

Data analysis indicated a robust association between STEAM education and the interdisciplinary integration within university dance, and it was statistically significant. In addition to the fact that the variables in the dataset were highly associated with one another, the properties of the dataset were also suited for an analysis of factors. This indicates a reasonable level of sampling adequacy with a KMO score of 0.895. In addition, Bartlett's Sphericity Test yielded p = 0.000, which was found to be highly significant. Additionally, the results of the ANOVA test were highly significant, further strengthening the relationship, with a significant F-value of 1154.598 and a distinct p-value of 0.000, which was below the 0.05 level of significance. As a result of these statistical data, the null hypothesis was rejected and the alternative hypothesis was accepted, which determined a statistically substantial relationship between STEAM education and university dance and multi-disciplinary integration. Overall, these outcomes emphasised the effectiveness of the interdisciplinary approach in higher educational settings. An essential predictive association between the research variables was established by the size of the F-value.

The findings of the current study determined that STEAM education acquired a meaningful and statistically substantial effect on the integration of university dance with multiple academic disciplines in higher education institutions in Shanghai, China. The investigation indicated that interdisciplinary methods based on STEAM principles significantly improved the involvement of pupils, imagination, and collaborative learning activities in dance education. The results indicated that STEAM-based pedagogical approaches have significantly enhanced interdisciplinary study in university dance programs. The findings align with previous research indicating that arts-integrated STEAM methodologies enhance students' creativity, analytical reasoning, and profound conceptual understanding. The research indicated that students participating in STEAM-oriented dance instruction gained a deeper comprehension of scientific and technological principles through embodied learning. The study's findings indicated that students engaged in STEAM-oriented dance education achieved a more profound comprehension of scientific and technological concepts. This understanding was achieved using physical

experiences. This corroborates the conceptual framework of embodied thinking, which underscores the significance of physical exercise in cognitive growth and knowledge acquisition. Moreover, the implementation of digital technology, including digital reality and AI, into education in dance substantially enhanced innovative and immersive learning experiences. Students investigated novel artistic expressions while acquiring knowledge in technology and science through these devices. As a result, pupils exhibited enhanced problem-solving skills and a more expansive multidisciplinary viewpoint. The research specified some additional problems. There had been a scarcity of academic support and specialised training for educators. There was a frequent transformation of multidisciplinary curriculum design. Despite these limitations, the study findings underscored the way STEAM education enhanced the university dance and evolved into a dynamic and multidisciplinary platform. It also encouraged the growth and provided learners with important expertise for modern educational and professional environments.

Conclusion

The study found that STEAM education has a significant impact on university dance's integration across several fields in academic institutes in Shanghai, China. The study showed that dance education has effectively transitioned from a simplistic artistic endeavour to a comprehensive learning framework that integrates the multidisciplinary nature of STEAM. The outcomes also demonstrated that students who participated in STEAM-based dance education enhanced their critical thinking, creativity, and teamwork abilities in their overall academic and professional growth. This STEAM-based dance learning method enhanced students' cognitive involvement and facilitated inventive learning strategies. Additionally, the integration of digital technology improved the learning environment and fostered experiential learning. The study yielded significant knowledge into the efficacy of STEAM-oriented multidisciplinary education by analysing innovative teaching strategies and improved student participation. It was established that institutional support, curricular design, and teacher training were essential for the successful implementation of integrative techniques. Overall, the findings of this study indicated that STEAM education fostered new practices and provided an effective framework for enhancing the quality of dance instruction in universities through the integration of many disciplines. It also afforded students extensive possibilities for learning that have facilitated their academic and creative growth. The research underscored the necessity of ongoing initiatives to enhance interdisciplinary teaching methodologies to adequately equip students for the intricate requirements of modern academic and professional landscapes.

This study is important for higher education, especially when it comes to designing collaborative courses and finding new processes to teach. Traditional teaching methods and multidisciplinary curriculum design may help educators learn about new ways to teach STEAM subjects. Based on the study's results, educational institutes may want to rethink how they teach and how they plan their courses. By adding dance to STEM education programs, dance students may be able to improve their imagination, critical thinking, and ability to learn from different fields. By combining dance with STEM education, teachers may be able to construct more interesting ways to teach. It may give institutions the support that they need to promote an interdisciplinary education system. This study may guide lawmakers by providing information. It may also help academic leaders to innovate new ideas for research that can be done in the arts education field about STEM education. Overall, it may deliver understanding to future researchers for

further investigation regarding the incorporation of university dance and multiple domains of STEAM education.

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Effects of Productive vs. Receptive Vocabulary Tasks on Low-Proficiency EFL Learners' Long-Term Retention and Transfer

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Abstract

With the rapid development of artificial intelligence in foreign language education, large language models have provided new pathways for vocabulary teaching. Traditional vocabulary learning mainly relies on receptive tasks (e.g., flashcard-based apps like Baicizhan), which often results in low-proficiency learners recognizing words but being unable to use them, or forgetting quickly after short-term memory. This study adopted a quasi-experimental design with 70 low-proficiency non-English majors (CET-4: 300–424, Gaokao: 60–89 out of 150) from Jiangxi Institute of Technology (JXIT). The participants were randomly divided into two groups, with 35 students in the experimental group and 35 in the control group. The experimental group adopted an AI-supported productive vocabulary-learning model, while the control group engaged in conventional receptive vocabulary learning through the Baicizhan platform. The intervention lasted eight weeks, with 30 minutes daily, 15 theme-based CET-4 words per day, totaling 600 words. Data were collected via pretest, immediate posttest and delayed posttest. Independent samples t-test, paired samples t-test, and effect size analysis were employed. The results revealed that the experimental group significantly outperformed the control group in both immediate and delayed posttests. The findings verify that compared with conventional receptive vocabulary learning, AI-supported productive vocabulary learning effectively improves long-term vocabulary retention and lexical transfer competence among low-proficiency EFL learners. This study provides a replicable AI-based teaching paradigm for vocabulary instruction targeting low-proficiency learners in private universities and offers new empirical evidence for second language vocabulary acquisition theories.

Keywords: AI-Assisted Learning, Baicizhan, Low-Proficiency EFL Learners, Long-Term Retention, Lexical Transfer, Productive Vocabulary Learning

Introduction

Vocabulary plays a crucial role in second language proficiency, serving as an indispensable foundation for learners' listening, speaking, reading, and writing abilities (Nation, 2022). However, vocabulary acquisition remains a persistent challenge for low-proficiency EFL learners in Chinese private universities. Although they often devote substantial time to memorizing words, they frequently struggle with rapid forgetting and difficulty using them appropriately in authentic contexts. A noticeable imbalance especially frequently exists between receptive vocabulary knowledge and productive vocabulary ability, with learners able to recognize words in reading tasks but unable to

actively use them in speaking or writing (Laufer & Goldstein, 2004). Such problems are especially common among learners with relatively weak English foundations, who tends to rely heavily on rote memorization and repetitive recognition-based exercises while learning vocabulary.

At present, commercial vocabulary, applications, such as Baicizhan and Shan bay, have become popular tools for vocabulary learning among Chinese college students. These applications mainly emphasize receptive learning activities, including form-meaning matching, picture recognition, and multiple-choice tasks. Such practices facilitate short-term memorization, but learners are provided with insufficient chances for contextualized output, active retrieval, and deeper semantic processing. According to Fergus I. M. Craik and Robert S. Lockhart's Depth of Processing Theory, memory retention is closely associated with the depth of cognitive processing involved during learning, and deeper semantic processing is more likely to produce durable long-term memory than shallow recognition-based learning (Craik & Lockhart, 1972). Similarly, studies on productive vocabulary learning suggest that active retrieval and contextualized language production are important for vocabulary internalization and transfer (Laufer & Hulstijn, 2001).

The emergence of large language models has brought fresh possibilities to optimize traditional vocabulary teaching and learning. Unlike rigid, exercise-oriented commercial vocabulary apps, modern AI learning tools can deliver contextualized interactive practice, real-time error feedback, and individualized learning support. Such adaptive features are particularly valuable for low-proficiency learners, who consistently need targeted guidance to improve their language skills. Swain's (1985) Comprehensible Output Hypothesis well supports the value of this AI-enabled learning mode. She argued that language production is far more than a simple display of acquired knowledge. Instead, it pushes learners to identify their linguistic deficiencies, test out language hypotheses, and engage in deeper cognitive processing of language rules. Within AI-supported learning environments, learners can practice and revise contextualized vocabulary output repeatedly, a flexible learning experience that traditional receptive training is unable to provide.

Despite growing academic attention on AI-assisted vocabulary learning, existing empirical research still has notable shortcomings. Existing intervention studies are mostly short-term in design and often involve limited vocabulary learning scopes or mixed-ability learner groups, which weakens the reliability and generalizability of their findings. Moreover, most prior research prioritizes learners' receptive vocabulary recognition while overlooking productive vocabulary transfer and long-term knowledge retention, which are the ultimate goals of vocabulary learning. Research focusing specifically on low-proficiency undergraduate learners in Chinese private universities also remains insufficient, leaving an underexplored research niche in local EFL contexts. Beyond that, most current studies treat AI tools merely as supplementary learning aids, rather than designing them as systematic pedagogical support to foster learners' productive vocabulary competence.

Against such a research backdrop, this study sets out to explore whether AI-based productive vocabulary tasks can better help low-proficiency EFL learners retain and transfer vocabulary knowledge in the long term, compared with conventional app-based receptive learning. Drawing on three classic theoretical frameworks—the Depth of Processing Theory (Craik & Lockhart, 1972), the Comprehensible Output Hypothesis

(Swain, 1985), and Vygotsky's Scaffolding Theory (1978)—this study compares the learning effects of AI-mediated productive vocabulary training and traditional receptive vocabulary learning. Its findings aim to provide empirical evidence for targeted vocabulary teaching design for low-proficiency learners and offer practical references for the effective integration of AI technology into EFL teaching in private university settings.

Review of Related Literature

In recent years, second language vocabulary acquisition research has made great progress in both theoretical development and technological applications. Scholars worldwide have extensively explored the limitations of traditional learning modes, the pedagogical value of output tasks, and the educational potential of artificial intelligence. Internationally, vocabulary knowledge is widely recognized as the foundation of language competence (Nation, 2022). A great number of empirical studies indicates that receptive learning via flashcard-based applications such as Quizlet and Mondly mainly enhances word recognition rather than deep lexical mastery. This approach often results in superficial learning characterized by "passive recognition without productive use" and rapid forgetting, with limited development of collocational competence and transfer ability (Jensen & Cadierno, 2022; Li & Zhang, 2022; Yang & Wang, 2024). Theoretically, Swain's Comprehensible Output Hypothesis (1985), Craik and Lockhart's Depth of Processing Theory (1972), and Task-Based Learning (TBLT) collectively demonstrate that productive tasks such as sentence creation, dialogue practice, and story retelling trigger deeper semantic processing, strengthen form-meaning-use connections, and promote long-term retention and lexical transfer (Swain, 1985; Yang et al., 2024; Hu, 2025). Recent research on working memory further suggests that learners with low working memory capacity benefit more from brief, low-cognitive-load productive tasks (Jin & Luo, 2026). With the rapid advancement of generative AI, studies have confirmed its ability to provide contextualized input, personalized scaffolding, real-time feedback, and low-anxiety interaction, effectively enhancing productive competence and lexical transfer, especially for low-proficiency learners (Alshahrani, 2024; Chen & Liu, 2025; Liu & Ma, 2025). A comprehensive meta-analysis by Şimşek et al. (2026), including 1,823 participants across 18 studies, revealed a large overall effect size ($g = 1.309$) for AI-assisted vocabulary learning, highlighting its effectiveness for low-proficiency learners. However, existing international research still suffers from short intervention periods, overreliance on receptive tasks, and insufficient empirical evidence focusing on Chinese low-proficiency learners.

In China, research reveals that Chinese university students, particularly those at private institutions with low English proficiency (CET-4 scores between 300 and 425), rely heavily on commercial apps such as Baicizhan for rote memorization, leading to persistent problems including weak retention, poor collocation, and a substantial gap between receptive and productive vocabulary (Zhou et al., 2016; Yu et al., 2022; Wu & Zhao, 2026). Yang et al. (2024) further noted that domestic studies on productive tasks often focus only on lexical depth rather than productive fluency. Recent domestic empirical research has shown that AI-assisted productive tasks significantly improve long-term retention and transfer compared to traditional app-based learning (Hao & Qi, 2025; Wang et al., 2024). A meta-analysis by Wang et al. (2025) also confirmed that 8-week interventions yield the most stable effects. Nevertheless, domestic scholarship still exhibits noticeable research gaps. Most local interventions adopt short-term designs, underutilise productive learning tasks, pay insufficient attention to private university low-

proficiency populations, and rarely conduct long-term tracking of vocabulary retention and transfer performance.

To sum up, despite widespread scholarly recognition of the value of productive tasks, deep cognitive processing and AI-enabled instruction in vocabulary learning, current research still lacks systematic eight-week intervention studies. There is also a lack of direct empirical comparisons between AI-assisted productive vocabulary training and conventional app-based receptive learning, as well as targeted evidence for low-proficiency non-English majors in private university settings. Hence, this study adopts an eight-week quasi-experimental design with low-proficiency students from a private university in Jiangxi. It compares how two learning approaches—AI-supported productive vocabulary practice and Baicizhan-based receptive learning—shape learners' immediate vocabulary acquisition, delayed retention and lexical transfer abilities. The research outcomes intend to provide practical empirical support for AI-driven vocabulary pedagogy in private university EFL classrooms and enrich context-specific data for second language vocabulary acquisition theories.

Research Questions

RQ1: Does AI-supported productive vocabulary learning yield better long-term vocabulary retention than Baicizhan-based receptive learning among low-proficiency EFL learners?

RQ2: Does AI-supported productive vocabulary learning facilitate better productive vocabulary transfer than Baicizhan-based receptive learning among low-proficiency EFL learners?

RQ3: What are low-proficiency EFL learners' learning experiences and perceptions regarding AI-supported productive vocabulary learning?

Methodology

This study used a quasi-experimental design with pre-test, immediate post-test, and delayed post-test to examine how two vocabulary-learning approaches affect low-proficiency EFL learners' vocabulary development. Quantitative data were collected to examine the differences in learners' short-term vocabulary mastery, long-term vocabulary retention, and productive vocabulary transfer ability between AI-supported productive vocabulary learning and traditional app-based receptive vocabulary learning. Overall, the quantitative statistical analysis ensured objective and credible research findings for verifying the effectiveness of different vocabulary learning interventions.

Research Design

A quasi-experimental design with pre-test, immediate post-test, and delayed post-test measurements was employed in this study. Participants were divided into an experimental group and a control group with all teaching and learning conditions strictly controlled to be identical, except for the core independent variable of vocabulary learning mode. The experimental group received an eight-week AI-supported productive vocabulary learning intervention, while the control group adopted conventional receptive vocabulary learning via the Baicizhan application.

Before the formal intervention, a vocabulary pre-test was conducted to verify the baseline homogeneity of vocabulary proficiency between the two groups. Upon the completion of the eight-week intervention, an immediate post-test was implemented to assess learners' short-term vocabulary mastery and productive transfer ability. Four weeks after the intervention, a delayed post-test was administered to measure learners' long-term vocabulary retention effects. Strict variable control measures were implemented throughout the experiment to eliminate the interference of irrelevant confounding factors and guarantee the validity and reliability of the experimental results.

Participants

The participants of this study were 70 second-year non-English major undergraduates from Jiangxi Institution of Technology, a private university in southeast China. All participants had received unified college English teaching for one academic year before the experiment, with consistent daily English learning arrangements and no participation in additional off-campus English training courses, which ensured the basic homogeneity of their learning background and English foundation. To screen typical low-proficiency EFL learners suitable for this intervention, authoritative and objective English proficiency indicators were adopted as selection criteria. Specifically, participants' CET-4 scores ranged from 300 to 425, and their National College Entrance Examination English scores (full score = 150) were between 60 and 89. This score range effectively screened learners with weak but improvable English foundations, avoiding extreme cases of zero-basis learners or proficient learners that might interfere with experimental validity. Furthermore, a pre-experiment vocabulary test confirmed that participants' initial mastery rate of target vocabulary ranged from 20% to 40%, indicating that most target words were new and learnable for participants, which successfully prevented floor and ceiling effects in experimental data.

All participants were randomly assigned to the experimental group and the control group, with 35 students in each group. Independent samples t-test results verified no significant difference in baseline vocabulary level and overall English proficiency between the two groups ($p > 0.05$). None of the participants had long-term experience in using AI learning tools or professional vocabulary learning applications, which effectively controlled potential confounding variables. All participants volunteered to participate in this study and signed informed consent forms.

Target Vocabulary Materials

The target vocabulary materials were screened from 739 official CET-4 high-frequency words embedded in the Baicizhan platform developed by Chengdu Superlove Technology Co., Ltd. This word bank was compiled in accordance with the latest national CET-4 syllabus and a corpus of 18 authentic CET-4 examination papers from the latest three years. Words in this list frequently appear in the listening, reading, translation, and writing sections of CET-4 examinations, serving as a authoritative and practical vocabulary resource for Chinese undergraduates preparing for CET-4 tests.

To align with participants' CEFR A2-B1 proficiency level and the eight-week intervention schedule, further screening was conducted on the original 739 words. Basic vocabulary that most learners had already mastered and obscure sophisticated words with low examination frequency were eliminated. Ultimately, 600 qualified core CET-4 high-frequency words were confirmed as the formal experimental materials. These words were categorized into eight thematic units, with one exclusive learning theme arranged per

week throughout the intervention. Learners learned 15 target words daily and 75 words weekly. The thematic grouping strengthened contextual connections between vocabulary items and facilitated learners' practical lexical application. The selected vocabulary maintained a reasonable part-of-speech proportion, including 40% nouns, 35% verbs, and 25% adjectives. This distribution conforms to the practical lexical application demands of daily English communication and CET-4 writing tasks. The pre-experiment vocabulary test results confirmed participants' low initial mastery of target vocabulary, ensuring the effectiveness and credibility of the subsequent intervention data.

Research Instruments

This study employed three parallel vocabulary test papers as the core research instrument, implemented as the pre-test, immediate post-test, and delayed post-test respectively. The three parallel tests maintained equivalent structures, full scores, difficulty levels, and item distributions. To minimize test practice effects and memorization bias, each test version adopted different sentence contexts, contextual prompts, and item arrangements while retaining unified assessment dimensions and evaluation standards.

Each test paper consisted of three sections to comprehensively measure three core dimensions of vocabulary learning outcomes: receptive vocabulary knowledge, productive vocabulary retrieval ability, and vocabulary transfer competence. The receptive vocabulary section adopted multiple-choice items to assess learners' ability to recognize and comprehend target words in contextualized sentences. The productive vocabulary section included sentence completion and guided sentence production tasks, which aimed to measure learners' productive word retrieval and contextualized lexical application ability. In addition, each test paper contained a contextualized vocabulary transfer writing task. Participants were required to complete an 80–100-word short paragraph in a new communicative context by applying designated target vocabulary items. This task was designed to examine learners' ability to transfer vocabulary knowledge from passive recognition and controlled production to spontaneous, meaningful contextualized use, rather than evaluating their overall English writing proficiency. The writing topics across the three tests were equivalent in difficulty and structural complexity but differed in situational prompts to avoid repeated memorization and ensure authentic test performance.

Instead of testing all 600 target words directly, the tests adopted a stratified proportional sampling approach. Test items were proportionally and evenly selected from different thematic units and instructional stages of the eight-week intervention, ensuring the representativeness and comprehensiveness of the assessment. The total score of each test paper was 100 points. To guarantee content validity, all test items were developed based on the CET-4 high-frequency vocabulary corpus consistent with the experimental learning materials and were reviewed by two experienced college English teachers specializing in vocabulary instruction and language assessment. Prior to the formal experiment, a pilot test was conducted among non-participant students with equivalent English proficiency. The results showed that the Cronbach's α coefficient of the test exceeded 0.80, indicating satisfactory internal consistency and reliable test stability.

For the vocabulary transfer writing task, the standardized scoring rubric covered four core dimensions: vocabulary accuracy, contextual appropriateness, grammatical correctness, and lexical diversity. Two experienced college English teachers independently rated all writing responses. Inter-rater reliability was calculated to ensure scoring consistency, and

the average score of the two raters was adopted as the final score for each participant to guarantee scoring objectivity and credibility.

Intervention Procedures

The entire intervention lasted eight weeks, with 30 minutes of fixed vocabulary learning arranged every weekday. All learning activities were completed uniformly under teacher supervision, ensuring consistent learning duration and learning intensity for all participants. Except for the differentiated vocabulary learning modes for the two groups, all other learning conditions, including the learning environment, schedule arrangement, and review requirements, remained completely identical to strictly control irrelevant variables.

Experimental Group: AI-Supported Productive Vocabulary Learning

Participants in the experimental group completed daily standardized productive vocabulary learning tasks guided by the Coze AI intelligent agent. The AI system was preset with a fixed and unified learning procedure to avoid random and invalid interactive content, ensuring standardized intervention quality throughout the experiment. The daily learning process comprised four core links: vocabulary presentation, productive sentence making, thematic contextual dialogue, and daily learning review.

Firstly, the AI systematically presented the phonetic symbol, part of speech, core meaning, common collocations, and typical example sentences of each target word. Secondly, learners were required to create independent original sentences with each target word, and the AI provided real-time error correction and targeted optimization guidance for grammatical errors, collocation mistakes, and contextual inappropriateness. Thirdly, the AI built exclusive thematic scenarios based on the weekly learning theme, guiding learners to complete contextual interactive dialogues using target words. Finally, the AI summarized learners' daily error types and key vocabulary knowledge to support targeted consolidation. The entire learning process focused on active lexical output and deep semantic processing to promote effective vocabulary internalization.

Control Group: Baicizhan-Based Receptive Vocabulary Learning

Participants in the control group learned the same 600 target vocabulary words via the Baicizhan application. The daily learning quantity, learning frequency, and eight-week intervention cycle were completely consistent with those of the experimental group. The learning mode was limited to traditional receptive vocabulary training, including picture flashcard recognition, word meaning matching, and multiple-choice tests. All output-related functions, personalized dialogue interactions, and manual editing functions of the application were manually disabled throughout the intervention.

Learners in the control group only completed passive word recognition and mechanical repetitive review of target vocabulary. Their learning process mainly relied on shallow form-meaning mapping, without any active vocabulary output, contextual application, or targeted error correction feedback, which was distinctly different from the deep productive learning mode of the experimental group.

Data Analysis Methods

This study adopted purely quantitative statistical analysis to process experimental data. All data were analyzed via SPSS 26.0 statistical software. A 2 (Group: AI vs. Baicizhan) × 3 (Time: Pretest, Immediate Posttest, Delayed Posttest) mixed-design ANOVA was

conducted to examine overall effects. Independent samples t-tests were used for between-group comparisons, and paired samples t-tests for within-group changes. Cohen's d was calculated to assess effect size.

Analysis

Table 1 presents the descriptive statistics of the vocabulary test scores for Group A (AI-assisted) and Group B (Baicizhan-based) across the pre-test, immediate post-test, and delayed post-test.

Table 1: Descriptive Statistics of Vocabulary Test Scores

	Pretest		Immediate posttest		Delayed posttest	
	Mean	SD	Mean	SD	Mean	SD
Group A	55.91	6.79	79.00	10.81	72.37	12.04
Group B	55.20	11.09	67.91	13.94	65.37	16.38

As shown in Table 1, the two groups demonstrated highly comparable vocabulary proficiency before the intervention. The mean pretest scores of the group A (55.91) and group B (55.20) were very close, indicating no substantial initial difference between the two groups. This result suggests that the participants shared a relatively homogeneous vocabulary foundation at the beginning of the experiment, thereby ensuring the validity of subsequent comparisons.

After the 8-week intervention, both groups improved in the immediate posttest; however, the group A achieved substantially greater gains than group B. The mean score of the AI group increased from 55.91 to 79.00, while the Baicizhan group improved from 55.20 to 67.91. The independent samples t-test further confirmed a statistically significant difference between the two groups in the immediate posttest ($t = 3.718$, $p = .001$), with a large effect size ($d = 0.889$). These findings indicate that AI-supported productive vocabulary learning was significantly more effective than receptive flashcard learning in facilitating vocabulary acquisition among low-proficiency EFL learners.

Figure 1 further illustrates the vocabulary score trajectories of the two groups across the three testing stages. As shown in Figure 1, the AI group demonstrated a steeper improvement trend after the intervention and maintained a relatively more stable retention pattern in the delayed post-test compared with the Baicizhan group.

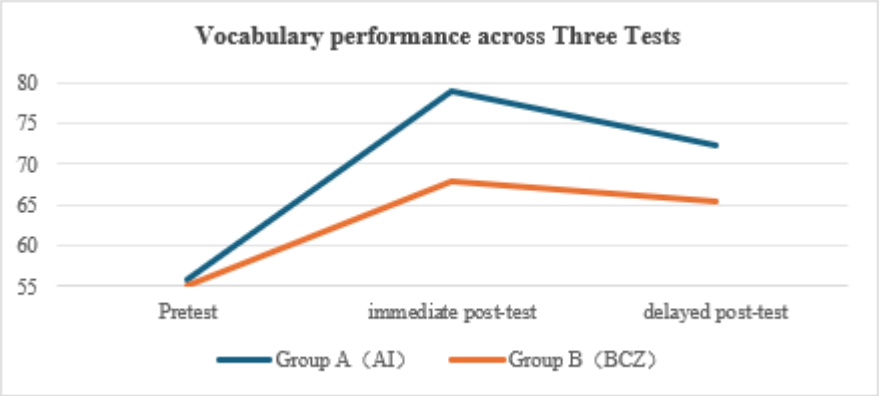

Figure 1. Vocabulary performance across Three Tests

The superior performance of the AI group may be attributed to the nature of the productive learning tasks. Unlike the receptive learning activities provided by Baicizhan, the AI-supported learning model required learners to actively retrieve and use target vocabulary through contextualized sentence production and guided dialogue interaction. Such tasks encouraged learners to integrate lexical meaning, contextual adaptation, and communicative intent simultaneously rather than relying solely on passive recognition and form-meaning matching. This finding strongly supports Depth of Processing Theory (Craik & Lockhart, 1972), which argues that deeper semantic processing contributes to stronger and more durable memory encoding.

The delayed post-test results further revealed important differences in long-term retention between the two learning approaches. Although both groups experienced some degree of forgetting after the intervention, the AI group maintained a considerably higher retention level than the Baicizhan group. More specifically, the AI group retained a delayed post-test mean score of 72.37; whereas the Baicizhan group obtained a lower mean score of 65.37. The statistical analysis also revealed a significant difference between the two groups in the delayed post-test ($p = .046$, $d = 0.487$), suggesting that AI-supported productive vocabulary learning contributed to stronger long-term vocabulary retention.

To further examine long-term retention performance, Figure 2 compares the vocabulary development trajectories of the two groups in terms of immediate learning gain, forgetting loss, and net retention. As illustrated in Figure 2, the AI group achieved substantially larger immediate learning gains (+23.09) than the Baicizhan group (+12.71). Although the AI group also showed a moderate decline in the delayed posttest, its final net retention gain (+16.46) remained considerably higher than that of the Baicizhan group (+10.17). These findings suggest that AI-supported productive vocabulary learning not only promotes stronger vocabulary acquisition but also leads to more durable long-term retention.

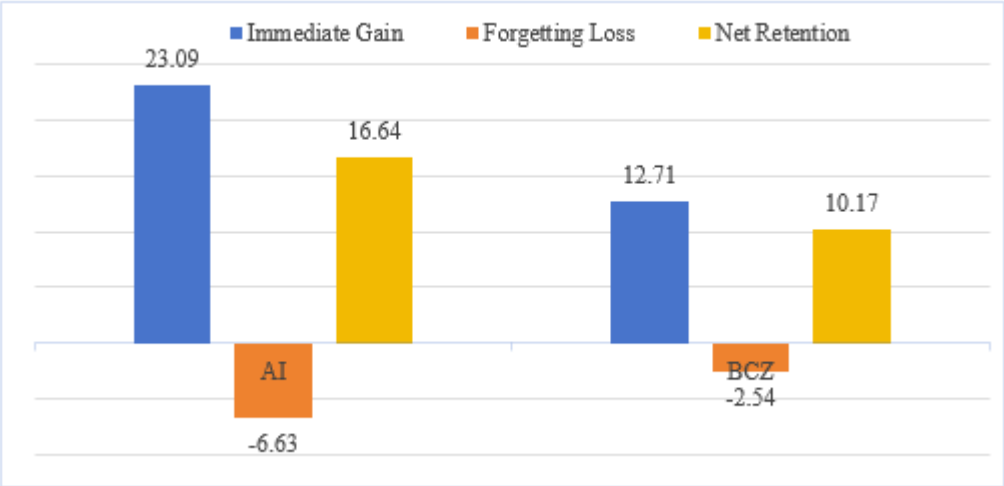

Figure 2. Vocabulary Retention Performance Between Groups

A key explanation lies in the repeated retrieval and contextualized application embedded in productive tasks. During AI dialogue interactions, learners actively retrieved target vocabulary, constructed original sentences, and responded to communicative prompts. This repeated productive retrieval strengthened lexical accessibility and reinforced memory consolidation, consistent with the retrieval practice effect in cognitive psychology: active retrieval enhances long-term retention more effectively than passive review (Karpicke & Roediger, 2008).

Furthermore, the AI system delivered immediate corrective feedback, adaptive prompts, and contextual scaffolding throughout the process. This dynamic support helped learners identify lexical gaps, revise inaccurate expressions, and gradually internalize vocabulary knowledge—aligning with Vygotsky's (1978) Scaffolding Theory, which highlights guided assistance for effective learning. For low-proficiency learners, who often lack confidence and autonomous strategies, AI-mediated interaction offered a low-anxiety environment for repeated productive practice.

In addition to vocabulary retention, the present study also investigated learners' vocabulary transfer ability through a writing task. Table 2 presents the descriptive statistics of writing scores across the three tests. At the pretest, the two groups were comparable in writing performance, with Group A scoring 8.54 (SD = 1.40) and Group B scoring 8.34 (SD = 1.39), indicating no significant baseline difference. After the 8-week intervention, Group A improved to 10.17 (SD = 2.26) in the immediate posttest, while Group B reached only 9.14 (SD = 2.05). In the delayed posttest, Group A maintained a stable score of 10.11 (SD = 2.18), whereas Group B declined slightly to 8.89 (SD = 2.32). Learners in the AI group demonstrated greater ability to use target vocabulary accurately and appropriately in new communicative situations. Their writing showed richer lexical variety, more natural collocations, and better contextual adaptation compared with the Baicizhan group.

Table 2: Descriptive Statistics of Writing Scores

	Pretest		Immediate posttest		Delayed posttest	
	Mean	SD	Mean	SD	Mean	SD

Group A	8.54	1.40	10.17	2.26	10.11	2.18
Group B	8.34	1.39	9.14	2.05	8.89	2.32

This finding suggests that productive vocabulary learning may facilitate the transformation of receptive vocabulary knowledge into active productive competence. While receptive flashcard learning may improve vocabulary recognition, it does not necessarily guarantee learners' ability to retrieve and apply vocabulary during authentic communication. In contrast, AI-supported productive tasks continuously pushed learners to produce language, test lexical hypotheses, and refine vocabulary usage through interaction. This result is consistent with Swain's (1985) Comprehensible Output Hypothesis, which highlights the crucial role of language output in second language development.

Overall, the findings consistently demonstrate that AI-supported productive vocabulary learning shows clear advantages over receptive flashcard learning in terms of immediate vocabulary acquisition, long-term retention, and vocabulary transfer ability. The study suggests that vocabulary learning effectiveness depends not merely on repetition frequency, but more importantly on the depth of cognitive processing, productive retrieval, and contextualized lexical engagement during learning. Moreover, the findings highlight the pedagogical potential of AI-assisted vocabulary learning systems as interactive scaffolding environments rather than simple digital memorization tools, particularly for low-proficiency EFL learners in private undergraduate institutions.

Findings and Discussion

Based on the statistical analyses of pretest, immediate posttest, and delayed posttest data, the present study yielded five key findings.

First, AI-supported productive vocabulary learning led to significantly better vocabulary performance than receptive flashcard learning. The AI group (Group A) outperformed the Baicizhan group (Group B) on both the immediate posttest ($p = .001$) and the two-week delayed posttest ($p = .046$), confirming the immediate and sustained advantages of productive practice.

Second, productive learning fostered superior long-term vocabulary retention. While both groups experienced some forgetting over time, the AI group maintained substantially higher delayed posttest scores (72.37 vs. 65.37) and a larger net retention gain (+16.46 vs. +10.17), indicating more durable lexical memory.

Third, AI-mediated practice significantly enhanced vocabulary transfer to writing. In the writing task, the AI group produced more accurate, contextually appropriate target words with richer collocations and better coherence. Their writing scores were consistently higher across all tests, especially in delayed retention ($p = .026$), reflecting stronger productive competence.

Fourth, productive tasks promoted deeper lexical processing and more stable encoding. Unlike passive recognition, AI-driven dialogue, sentence construction, and immediate

feedback required active retrieval, semantic analysis, and contextual adjustment. This aligns with Depth of Processing Theory (Craik & Lockhart, 1972) and retrieval practice effects (Karpicke & Roediger, 2008), strengthening long-term memory traces.

Finally, AI tools show clear pedagogical value for low-proficiency EFL learners in private undergraduate settings. When designed as interactive, output-oriented scaffolding systems rather than simple memorization tools, AI-supported tasks effectively improve vocabulary acquisition, retention, and transfer.

Conclusion

This quasi-experimental study compared the effects of AI-supported productive vocabulary learning and conventional receptive flashcard learning over eight weeks with low-proficiency EFL learners at JXIT as subjects. The experimental data revealed that the AI group achieved far better results than the control group. Their advantages lay in long-term vocabulary retention and lexical transfer, and the differences between the two groups were statistically significant. The findings indicate that AI-enabled contextualized practice encourages deeper cognitive engagement, strengthens lexical retrieval, and enhances long-term retention. By prompting learners to use words in meaningful interactions and receive timely feedback, AI systems help transform passive receptive knowledge into flexible productive competence, as predicted by Swain's (1985) Comprehensible Output Hypothesis.

Pedagogical implications for low-proficiency EFL instruction are clear. First, vocabulary teaching should shift from rote memorization to contextualized productive use. Second, AI tools should be integrated as adaptive scaffolding environments—not just digital flashcards—to support output practice, error correction, and gradual skill development. Third, instruction should prioritize sustainable retention and transfer over short-term recognition gains. For AI application development, the results highlight that interaction-driven, output-focused design better supports lexical growth than receptive-only models. Future tools could embed more authentic communicative scenarios and personalized feedback loops.

Several limitations must be acknowledged. The sample was limited to one institution, restricting generalizability. The eight-week intervention period only captured short-to-medium effects; longer-term outcomes remain unexamined. Future research could include larger, more diverse samples, extended interventions, and mixed-methods data (e.g., interaction logs, learner interviews) to explore underlying learning mechanisms. In summary, AI-supported productive vocabulary learning is a pedagogically effective, learner-centred approach for low-proficiency EFL learners. It offers a practical, sustainable way to improve vocabulary acquisition, retention, and transfer in private undergraduate contexts.

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Institutional Constraints and the Implementation Gap in Multicultural Education: A Conceptual Analysis of Chinese Higher Education Internationalisation

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Abstract

Globalisation and higher education internationalisation have significantly reshaped university governance and educational practices worldwide. In China, universities have rapidly expanded international cooperation programmes, transnational curriculum systems, and global academic partnerships under conditions of digital transformation and educational modernisation. However, despite the continuous expansion of higher education internationalisation, multicultural education outcomes remain uneven across institutions. Significant disparities persist in institutional governance capacity, curriculum implementation, intercultural interaction, and organisational adaptability. Existing studies primarily focus on curriculum reform and internationalisation strategies while paying insufficient attention to the structural mechanisms shaping implementation outcomes. This paper therefore develops an integrated analytical framework to examine how institutional constraints, digital transformation, global transformation, and international political environments jointly contribute to the implementation gap in multicultural education within Chinese higher education. Using a conceptual and comparative analytical approach, the study analyses representative institutional models, including elite transnational universities and resource-constrained local universities. The paper argues that multicultural education outcomes are mediated by institutional governance capacity and implementation effectiveness rather than by internationalisation expansion alone. The study contributes to the literature by integrating implementation theory, governance analysis, and higher education internationalisation into a unified conceptual framework.

Keywords: Chinese Universities, Digital Transformation, Higher Education Internationalisation, Implementation Gap, Institutional Constraints, Multicultural Education

Introduction

Globalisation and higher education internationalisation have significantly reshaped university governance, academic collaboration, and educational practices worldwide (de Wit & Altbach, 2021; Marginson, 2023). Universities increasingly participate in transnational academic cooperation, international curriculum development, and global educational exchange as part of broader processes of educational modernisation and global integration. In China, higher education internationalisation has accelerated rapidly through the expansion of international cooperation programmes, Sino-foreign

educational partnerships, overseas academic collaboration, and English-medium instruction systems (Yang, 2022).

The rapid expansion of higher education internationalisation has also transformed the governance structure and educational objectives of universities. Chinese universities increasingly seek to improve global competitiveness, academic reputation, and international influence through global partnerships and international curriculum systems. In recent years, internationalisation has become closely connected with broader national strategies related to educational modernisation, digital transformation, and global talent development. As a result, universities are expected not only to strengthen international academic cooperation, but also to cultivate intercultural understanding and multicultural competencies among students.

At the same time, digital transformation has increasingly influenced university governance structures, curriculum delivery, and educational management systems (OECD, 2023; UNESCO, 2024). The growing integration of digital platforms, online learning systems, and AI-supported educational technologies has expanded opportunities for international academic interaction and institutional coordination. Digital learning environments, virtual exchange programmes, and online collaborative teaching models have become increasingly important components of higher education internationalisation, particularly following the acceleration of global digitalisation in the post-pandemic period.

However, recent studies suggest that digital transformation and higher education internationalisation remain uneven across institutions due to differences in governance capacity, technological infrastructure, organisational adaptability, and resource allocation (Selwyn, 2022). Elite universities generally possess stronger technological resources, more advanced digital governance systems, and greater access to international educational networks. In contrast, many local and resource-constrained universities continue to experience challenges in technological implementation, faculty internationalisation, and intercultural learning support. These institutional disparities increasingly affect the implementation effectiveness of multicultural education within higher education systems.

Within this broader context, multicultural education has become an important component of higher education internationalisation. Multicultural education emphasises intercultural understanding, educational equity, cultural inclusiveness, and the development of global competencies among students (Banks, 2021; Leask, 2022). Universities are increasingly expected to create learning environments that support intercultural interaction and multicultural engagement in response to growing educational diversity and international academic integration.

Despite the continuous expansion of internationalisation policies and international education programmes, multicultural education outcomes remain uneven across Chinese universities. Existing research indicates that intercultural interaction, curriculum implementation, and multicultural learning experiences vary significantly across institutions (de Wit, 2020). In some universities, multicultural education is deeply integrated into curriculum design, student services, and institutional governance systems. In other institutions, however, multicultural education remains

limited to symbolic internationalisation policies without substantial intercultural learning transformation.

Existing studies have primarily focused on curriculum reform, intercultural competence development, and internationalisation strategies while paying comparatively limited attention to the structural mechanisms shaping implementation outcomes. In particular, insufficient research has examined how institutional constraints, digital transformation, global transformation, and international political environments jointly contribute to the implementation gap in multicultural education within Chinese higher education. The relationship between governance capacity and implementation effectiveness therefore remains insufficiently explored within existing literature.

Therefore, this study aims to develop a conceptual analytical framework to examine how multiple structural factors influence multicultural education implementation under conditions of higher education internationalisation and digital transformation. The study argues that multicultural education outcomes are shaped not only by internationalisation expansion itself, but also by institutional governance capacity, implementation effectiveness, and organisational adaptability. By integrating implementation theory, governance analysis, and higher education internationalisation studies, this paper seeks to provide a more comprehensive understanding of the structural factors influencing multicultural education implementation in Chinese universities.

Review of Related Literature

The internationalisation of Chinese higher education has expanded through global partnerships, student mobility, English-medium programmes, research collaboration, and digital learning. However, the literature suggests that internationalisation does not automatically produce effective multicultural education. A major concern is the implementation gap between institutional policy and actual classroom or campus practice.

Multicultural education is grounded in equity, inclusion, cultural recognition, and institutional transformation. Banks (2021) argues that multicultural education requires more than the presence of diverse students; it demands curriculum reform, inclusive pedagogy, prejudice reduction, and an empowering institutional culture. Similarly, Gay (2020) emphasizes culturally responsive teaching, where students' cultural backgrounds are treated as resources for learning. These ideas are highly relevant to Chinese universities as they engage with increasingly diverse student populations and global academic expectations.

Internationalisation is also a complex and contested concept. Knight (2021) explains that it includes international, intercultural, and global dimensions in higher education. De Wit (2020) and de Wit and Altbach (2021) caution that internationalisation should not be reduced to rankings, mobility statistics, or market-driven goals. Instead, it should be ethical, qualitative, and inclusive. In China, however, internationalisation is often linked to competitiveness, institutional prestige, and national development goals, which may limit attention to multicultural learning (Yang, 2022).

Curriculum is a key area where the implementation gap becomes visible. Leask (2022) argues that internationalising the curriculum requires integrating intercultural and global perspectives into learning outcomes, content, pedagogy, and assessment. Yet Chinese higher education institutions may face constraints such as rigid curricula, language barriers, limited faculty training, and uneven institutional resources.

Policy implementation theory further explains this gap. Pressman and Wildavsky (2020) show that policies often fail when goals are unclear, coordination is weak, and local capacity is insufficient. This applies to multicultural education when universities adopt internationalisation strategies without aligning governance, teaching practices, student support, and faculty development. Digital transformation also affects internationalisation. OECD (2023), Selwyn (2022), and UNESCO (2024) note that technology can expand global learning but may reproduce inequalities if not guided by inclusion. Castells' (2021) network society perspective further shows that universities participate unequally in global knowledge networks.

Overall, the literature indicates that the implementation gap in multicultural education within Chinese higher education internationalisation results from institutional constraints, limited pedagogical readiness, policy-practice mismatch, and uneven digital and global capacities.

Objectives

The objectives of this article are to examine institutional constraints that affect the implementation of multicultural education within the internationalisation of Chinese higher education and to analyse governance capacity in shaping the effectiveness of related policies. It seeks to identify gaps between internationalisation policy objectives and actual practices, while also exploring curriculum design as a driver of intercultural learning and engagement among students. Another key objective is to assess faculty preparedness in supporting culturally responsive teaching within internationalised settings.

In addition, the study aims to investigate digital transformation and its influence on multicultural education implementation, while analysing the impact of unequal technological infrastructure and institutional resources on internationalisation outcomes. It also seeks to understand global academic networks and international cooperation as factors shaping multicultural practices. Ultimately, the article intends to develop a conceptual framework linking institutional constraints, implementation gaps, and educational outcomes, and to provide theoretical insights for improving inclusive, ethical, and effective multicultural education within the broader context of Chinese higher education internationalisation.

Methodology

Conceptual Framework

This study adopts a conceptual analytical approach because multicultural education implementation within higher education internationalisation involves complex institutional, technological, political, and governance-related dimensions. Existing studies suggest that internationalisation policies alone cannot fully explain differences in multicultural education outcomes across universities (de Wit & Altbach, 2021). Instead, implementation effectiveness is often influenced by broader institutional structures, governance capacity, resource allocation, and organisational adaptability.

As higher education systems become increasingly interconnected through globalisation and digital transformation, universities are required to respond simultaneously to international academic competition, technological change, and intercultural educational demands.

Implementation theory provides an important analytical foundation for this study. Pressman and Wildavsky (2020) argue that policy implementation outcomes frequently diverge from policy intentions due to administrative fragmentation, coordination difficulties, and institutional complexity. In higher education contexts, universities operate under different governance environments, financial conditions, organisational cultures, and institutional capacities, which significantly influence policy implementation effectiveness. Consequently, similar internationalisation policies may produce substantially different multicultural education outcomes across institutions. The study is therefore structured around an IV–MV–DV analytical framework to explain how multiple structural factors jointly influence multicultural education implementation in Chinese universities. The independent variables (IVs) include institutional constraints, digital transformation, global transformation, and international political environments. These variables increasingly shape university governance systems, curriculum coordination, resource allocation, digital capability, and organisational decision-making processes within higher education internationalisation.

Institutional constraints refer to differences in governance structures, administrative coordination, financial resources, faculty internationalisation, and organisational flexibility across universities. Existing research indicates that universities with stronger governance capacity and more stable internationalisation systems are generally better positioned to implement multicultural education effectively (Marginson, 2023). In contrast, resource-constrained universities may experience limitations in intercultural curriculum implementation, international student support, and multicultural learning coordination. Digital transformation is included as an independent variable because digital governance increasingly influences educational administration, online learning systems, intercultural communication, and international academic collaboration (OECD, 2023). Universities with stronger technological infrastructure and digital governance systems are more capable of supporting virtual international learning environments, AI-supported educational management, and online intercultural interaction. However, uneven digital capability across institutions may further intensify educational inequality and implementation disparities.

Global transformation and international political environments are also incorporated into the framework because higher education internationalisation increasingly operates within unstable global conditions. Changes in geopolitical relations, international educational governance, global mobility patterns, and transnational academic cooperation significantly affect university internationalisation strategies and programme sustainability (UNESCO, 2024). These external structural conditions influence not only policy implementation processes, but also institutional adaptability and governance effectiveness. The mediating variable (MV) within the framework is the implementation gap, which refers to the divergence between policy objectives and actual institutional practice. The study argues that institutional conditions do not directly determine multicultural education outcomes. Instead, implementation

effectiveness functions as a central mediating mechanism connecting governance structures and educational performance. Universities with stronger governance capacity, more stable internationalisation systems, and greater organisational flexibility are generally better positioned to translate policy objectives into effective multicultural educational practice.

The dependent variable (DV) is multicultural education outcomes, including curriculum implementation effectiveness, intercultural learning interaction, educational inclusiveness, student global competency development, and the sustainability of multicultural educational practices. The framework therefore explains how institutional conditions and governance structures influence multicultural education implementation outcomes through the mediating process of implementation effectiveness. The conceptual framework also reflects the growing influence of digital governance within higher education internationalisation. Universities increasingly rely on online learning platforms, AI-supported educational technologies, digital administrative systems, and virtual international collaboration mechanisms to coordinate teaching and academic management (Selwyn, 2022). Digital transformation therefore functions not only as a technological process, but also as a governance mechanism influencing implementation capacity, organisational coordination, and institutional adaptability.

Overall, the conceptual framework developed in this study provides an integrated perspective for understanding how governance conditions, institutional capacity, digital transformation, and implementation processes jointly shape multicultural education outcomes within Chinese higher education internationalisation.

Comparative Analytical Approach

Expanded Addition for 2.2 Comparative Analytical Approach

This study further employs a comparative analytical approach to examine differences between highly internationalised universities and resource-constrained institutions in terms of governance structure, digital capability, curriculum implementation, and intercultural learning support (Leask, 2022; Selwyn, 2022). Comparative analysis is appropriate because Chinese universities demonstrate substantial variation in internationalisation intensity, governance systems, financial resources, organisational adaptability, and access to global educational networks.

Highly internationalised universities often possess stronger international partnerships, more advanced digital governance systems, and greater access to global educational resources. These institutions are generally better positioned to integrate multicultural education into curriculum systems, intercultural activities, international student services, and institutional governance structures. In many cases, multicultural education is incorporated into broader university internationalisation strategies through bilingual curriculum delivery, intercultural training programmes, international faculty recruitment, and overseas academic cooperation initiatives.

By comparison, many local and resource-constrained universities continue to face limitations in technological infrastructure, faculty internationalisation, intercultural programme coordination, and institutional governance capacity. Although these universities may formally adopt internationalisation policies, practical implementation often remains constrained by financial limitations, administrative fragmentation,

uneven resource allocation, and insufficient organisational flexibility. As a result, multicultural education implementation may remain symbolic or policy-oriented rather than deeply integrated into curriculum and student learning experiences.

The comparative analytical approach therefore enables the study to examine how governance differences influence multicultural education outcomes under conditions of rapid global transformation. Existing research suggests that governance capacity significantly affects policy coordination, implementation efficiency, and institutional adaptability within higher education systems (Marginson, 2023). Universities with stronger organisational coordination and international governance structures are generally more capable of translating internationalisation policies into effective multicultural educational practices.

In addition, comparative analysis allows the study to explore the relationship between digital transformation and institutional inequality. Universities increasingly rely on digital learning platforms, AI-supported governance systems, virtual international classrooms, and online academic collaboration mechanisms to support internationalisation processes. However, uneven digital capability across institutions may further intensify disparities in multicultural educational access and implementation effectiveness. Universities with stronger technological resources are more capable of facilitating intercultural communication, international collaboration, and flexible learning environments, whereas less-resourced institutions may struggle to maintain sustainable digital internationalisation systems.

The comparative approach also helps explain why similar national internationalisation policies may produce substantially different institutional outcomes. Although universities operate under the same national higher education policy framework, institutional implementation processes differ significantly due to variations in governance structures, leadership capacity, organisational culture, and institutional priorities. Consequently, multicultural education implementation should be understood not only as a policy issue, but also as an institutional governance issue shaped by organisational conditions and implementation capability.

Furthermore, international political environments and global uncertainty increasingly affect university internationalisation strategies and institutional decision-making processes. Changes in geopolitical relations, international mobility patterns, and global academic cooperation structures continue to influence student exchange, transnational partnerships, and international programme sustainability (UNESCO, 2024). Universities therefore demonstrate different levels of institutional resilience and adaptability when responding to global educational transformation and international political change.

Overall, the comparative analytical approach adopted in this study provides a broader institutional perspective for understanding how governance structures, resource allocation, digital capability, and organisational adaptability jointly influence multicultural education implementation outcomes across Chinese universities.

Analysis

The article explores the intersection of educational practices, technology integration, and learner engagement, highlighting how modern pedagogical strategies influence

student outcomes. It emphasizes the critical role of innovative instructional methods and digital tools in enhancing knowledge acquisition and promoting active participation. The findings suggest that a thoughtful combination of traditional and technology-driven teaching approaches leads to more effective learning experiences, fostering higher levels of comprehension and retention among students. Notably, the study underscores the importance of adaptability and responsiveness in instructional design, aligning content delivery with learners' cognitive needs and contextual realities. Furthermore, the research identifies a direct correlation between teacher facilitation, digital literacy, and student motivation. By integrating interactive platforms, simulations, and collaborative learning environments, educators can bridge gaps in engagement and foster a culture of continuous learning. The analysis reveals that technology is not merely a supplementary tool but a transformative element capable of reshaping classroom dynamics and enhancing educational equity. The role of feedback, assessment, and personalized learning is also highlighted as crucial in monitoring student progress and informing pedagogical adjustments, thereby ensuring that learning objectives are consistently met.

Lastly, the study situates these findings within broader educational frameworks, suggesting that policy, infrastructure, and teacher training are pivotal to sustaining the impact of innovative practices. Challenges such as resource limitations, varying levels of digital competency, and resistance to change are acknowledged, yet the article demonstrates that strategic planning, professional development, and inclusive practices can mitigate these obstacles. Overall, the analysis confirms that a holistic approach combining pedagogical innovation, technology integration, and responsive educational policies can significantly enhance learning outcomes and prepare students for future academic and professional demands.

Findings and Discussion

Higher Education Internationalisation and Institutional Differences

Higher education internationalisation has expanded significantly across Chinese universities through international cooperation programmes, transnational education partnerships, overseas academic exchange, and English-medium instruction systems (Yang, 2022; Marginson, 2023). However, the implementation effectiveness of multicultural education remains uneven across institutions due to differences in governance capacity, institutional resources, and organisational adaptability. The rapid expansion of higher education internationalisation has reshaped curriculum structures, university governance systems, student mobility patterns, and institutional development strategies within Chinese higher education. Universities increasingly seek to improve international competitiveness and global academic visibility through overseas partnerships, international curriculum integration, and cross-border educational cooperation. Internationalisation is therefore no longer limited to student exchange programmes, but has become closely connected with institutional governance transformation and global educational participation.

Elite transnational universities and highly internationalised institutions generally possess stronger global academic networks, more stable governance structures, and greater access to international educational resources. These universities are often better positioned to implement international curriculum systems, support intercultural learning environments, and coordinate multicultural educational practices. Many highly internationalised universities actively integrate multicultural education into

institutional governance strategies, student development programmes, and international academic collaboration initiatives. For example, some transnational universities operating in China adopt bilingual curriculum systems, globally oriented teaching models, and intercultural engagement programmes designed to strengthen students' international competencies and multicultural communication abilities. International faculty recruitment, overseas academic partnerships, and international research collaboration further contribute to the development of multicultural educational environments within these institutions. In contrast, resource-constrained universities frequently encounter challenges in curriculum coordination, faculty internationalisation, digital infrastructure, and multicultural learning support (de Wit, 2020; Leask, 2022). Although many universities formally adopt higher education internationalisation policies, practical implementation may remain limited due to insufficient financial resources, uneven organisational coordination, and restricted access to global academic networks. Institutional disparities also influence students' intercultural learning experiences. Students studying in highly internationalised universities are generally more likely to access intercultural interaction opportunities, international academic exchange activities, bilingual learning environments, and globally integrated curriculum systems. By comparison, students in less internationalised institutions may experience fewer opportunities for intercultural engagement and multicultural learning participation.

Existing studies further suggest that internationalisation expansion does not automatically produce effective multicultural education outcomes because intercultural interaction and multicultural engagement often remain limited across institutions (Banks, 2021). In some cases, universities prioritise international rankings, overseas partnerships, and symbolic internationalisation indicators without fully integrating multicultural educational practices into daily teaching and student learning experiences. Consequently, structural internationalisation does not necessarily guarantee meaningful multicultural educational transformation. Furthermore, differences in institutional leadership and governance coordination significantly influence implementation effectiveness. Universities with stronger governance capacity are generally more capable of coordinating curriculum reform, international faculty development, intercultural student support, and digital educational management. In contrast, fragmented administrative structures and weak organisational coordination may reduce the effectiveness of multicultural education implementation despite formal internationalisation policies.

The differences between university types can be further illustrated through comparative institutional characteristics presented in Table 1. These institutional inequalities demonstrate that multicultural education implementation is closely associated with governance capacity, resource allocation, organisational adaptability, and internationalisation intensity within higher education systems.

Table 1. Comparative Institutional Characteristics

Table 1. Comparative Institutional Characteristics

Dimension	Highly Internationalised Universities	Resource-Constrained Universities
Governance Capacity	Strong international governance systems	Limited coordination capacity
Digital Infrastructure	Advanced digital and AI-supported systems	Uneven digital capability
Curriculum Implementation	Stable international curriculum integration	Fragmented curriculum coordination
Faculty Internationalisation	Higher level of international academic engagement	Limited international faculty exposure
Multicultural Learning Support	Strong intercultural learning environment	Inconsistent multicultural support

Highly Internationalised Universities

Highly internationalised universities represent an important institutional model within Chinese higher education internationalisation. These universities generally possess stronger international governance systems, greater access to global academic resources, and more advanced intercultural educational environments. In recent years, transnational universities and Sino-foreign cooperative institutions such as New York University Shanghai, Duke Kunshan University, and Xi'an Jiaotong-Liverpool University have increasingly become representative examples of internationalised higher education development in China. These universities often adopt bilingual or English-medium curriculum systems and emphasise intercultural learning interaction within teaching and campus governance structures. International faculty recruitment, overseas academic cooperation, globally integrated curriculum design, and multicultural student environments are commonly incorporated into institutional internationalisation strategies. As a result, students within these universities are generally exposed to stronger intercultural communication opportunities and more internationally oriented learning environments.

Highly internationalised universities also demonstrate stronger organisational adaptability and governance coordination capacity. Their institutional structures are often designed to support flexible curriculum management, international academic collaboration, and digital educational integration. In many cases, universities rely on online learning systems, AI-supported educational technologies, and virtual international collaboration platforms to facilitate transnational academic interaction and multicultural educational participation. Furthermore, these universities frequently possess more stable financial resources and stronger international academic networks, enabling them to sustain long-term internationalisation initiatives and multicultural educational programmes. International student support services, intercultural activities, overseas exchange opportunities, and globally oriented academic training are often more systematically integrated into university governance systems. Consequently, multicultural education implementation within these institutions is generally more comprehensive and institutionally coordinated.

However, existing studies suggest that even highly internationalised universities may still encounter challenges in achieving meaningful multicultural integration (Banks, 2021). Internationalisation does not automatically guarantee deep intercultural engagement among students. In some cases, multicultural interaction remains limited to formal institutional activities rather than substantial intercultural learning transformation. Differences in language proficiency, cultural adaptation, and student participation may continue to affect multicultural educational outcomes despite advanced internationalisation structures.

Resource-Constrained Universities

In contrast, many local and resource-constrained universities continue to face substantial limitations in implementing multicultural education effectively. Although these institutions increasingly adopt higher education internationalisation policies, implementation capacity often remains uneven due to financial constraints, administrative fragmentation, and limited access to international academic networks. Many local universities continue to prioritise administrative internationalisation indicators, such as formal cooperation agreements and international programme expansion, without sufficient institutional capacity to support long-term multicultural educational development. Limited funding, insufficient technological infrastructure, and uneven faculty internationalisation may reduce universities' ability to establish sustainable intercultural learning environments.

Faculty internationalisation also remains uneven across institutions. Universities with limited access to international academic resources may experience difficulties in recruiting internationally experienced faculty members or providing intercultural professional development opportunities for teaching staff. Consequently, multicultural educational practices may remain insufficiently integrated into curriculum implementation and classroom interaction. Digital inequality further contributes to institutional disparities. Some universities lack advanced online learning systems, digital governance mechanisms, and virtual international collaboration platforms necessary for supporting international academic interaction and intercultural communication. These limitations became particularly visible during periods of accelerated global digital transformation and post-pandemic educational adjustment.

In addition, students studying in less internationalised universities may experience fewer opportunities for intercultural engagement, overseas academic exchange, and global competency development. Although universities may formally promote internationalisation strategies, actual multicultural educational experiences often remain limited within daily teaching and institutional practice. These institutional inequalities demonstrate that multicultural education implementation is closely associated with governance capacity, organisational adaptability, resource allocation, and digital infrastructure. As a result, implementation outcomes remain highly uneven across Chinese universities despite the continued expansion of national higher education internationalisation policies.

Digital Transformation and Governance Capacity

Digital transformation increasingly functions as a governance mechanism shaping institutional coordination, curriculum delivery, and international academic interaction within higher education systems (OECD, 2023; UNESCO, 2024). Universities

increasingly rely on digital learning platforms, AI-supported educational technologies, and online governance systems to facilitate academic administration and international collaboration. The rapid expansion of digital technologies has significantly transformed educational management, teaching methods, student interaction, and institutional governance structures within universities. Online learning systems, virtual classrooms, cloud-based academic management platforms, and AI-supported educational technologies increasingly influence how universities organise internationalisation and multicultural educational practices. As higher education systems become more digitally integrated, universities are expected to develop flexible governance mechanisms capable of supporting transnational academic communication and intercultural learning interaction.

Following the post-pandemic acceleration of global digitalisation, virtual internationalisation has become an increasingly important component of higher education internationalisation. Universities now utilise online exchange programmes, virtual mobility initiatives, international collaborative classrooms, and digital intercultural learning platforms to maintain international academic cooperation and student interaction across national boundaries. Digital transformation therefore expands opportunities for international educational participation beyond traditional physical mobility programmes. However, digital transformation remains highly uneven across institutions. Universities differ significantly in technological infrastructure, digital governance capacity, financial resources, and faculty digital competence (Selwyn, 2022). Well-resourced universities are generally more capable of integrating digital governance systems and international online learning environments into institutional practice, whereas less-resourced institutions often experience difficulties in technological implementation and organisational adaptation.

Digital governance capacity increasingly influences universities' ability to coordinate curriculum delivery, student services, academic administration, and intercultural educational support. Universities with stronger technological resources are often better positioned to establish online intercultural communication platforms, virtual international learning environments, and AI-supported academic management systems. In contrast, institutions with weaker digital infrastructure may struggle to maintain effective international educational coordination and sustainable multicultural engagement. Faculty digital competence also plays an important role in multicultural education implementation. Teaching staff increasingly require the ability to utilise online teaching platforms, digital communication tools, and intercultural learning technologies within internationalised educational environments. Universities with stronger faculty training systems and digital support mechanisms are generally more capable of adapting to rapidly changing educational technologies and global academic interaction models.

In addition, digital inequality may further reinforce institutional disparities rather than reduce them. Universities with stronger governance capacity and technological infrastructure are more capable of supporting international academic communication, flexible online learning, and multicultural educational participation. By comparison, resource-constrained universities may continue to face challenges related to technological investment, digital governance coordination, and online educational accessibility. Consequently, uneven digital capability may intensify implementation disparities across higher education institutions. The influence of AI-supported

educational technologies has also become increasingly significant in recent years. Universities increasingly apply AI systems in academic administration, student management, online learning analytics, and educational decision-making processes. Although these technologies may improve administrative efficiency and institutional coordination, they may also generate new governance challenges related to technological inequality, educational accessibility, and institutional adaptability.

Furthermore, digital transformation should not be understood solely as a technological issue. Instead, it increasingly represents a governance issue involving institutional coordination, organisational flexibility, policy implementation capacity, and resource allocation. Universities with stronger governance adaptability are generally more capable of integrating digital technologies into internationalisation strategies and multicultural educational systems. By contrast, fragmented governance structures and weak institutional coordination may reduce implementation effectiveness despite technological expansion.

Table 2 further summarises the major structural factors contributing to the implementation gap in multicultural education.

Table 2. Factors Contributing to the Implementation Gap

Table 2. Factors Contributing to the Implementation Gap

Factor	Influence on Multicultural Education
Institutional Constraints	Uneven governance structures, limited administrative coordination, and insufficient institutional capacity reduce implementation effectiveness across universities.
Digital Inequality	Unequal digital infrastructure, limited online learning platforms, and insufficient technological resources restrict online intercultural interaction and international academic collaboration.
Resource Allocation	Uneven funding distribution leads to unequal curriculum implementation, limited multicultural support services, and insufficient internationalisation investment.
Faculty Internationalisation	Differences in faculty international experience, intercultural teaching competence, and professional development opportunities affect the quality of multicultural education.
Global Political Environment	Geopolitical uncertainties, policy restrictions, and international tensions reduce the stability of academic cooperation and limit the sustainability of internationalisation initiatives.

Overall, digital transformation increasingly shapes governance capacity, organisational coordination, and multicultural education implementation within higher education internationalisation. Nevertheless, uneven digital capability and institutional inequality continue to influence the sustainability and effectiveness of multicultural educational practices across Chinese universities.

Implementation Gap in Multicultural Education

The implementation gap represents the divergence between internationalisation policy objectives and actual institutional practice (Pressman & Wildavsky, 2020). In the context of Chinese higher education, this gap is shaped by institutional constraints, governance fragmentation, digital inequality, and differences in organisational adaptability. Although universities increasingly promote multicultural education and internationalisation strategies, implementation outcomes remain inconsistent across institutions. Elite universities generally demonstrate stronger implementation effectiveness due to more stable governance systems, higher levels of internationalisation, and greater institutional flexibility. Meanwhile, many resource-constrained universities continue to face limitations in curriculum delivery, intercultural programme coordination, faculty development, and student support systems (Marginson, 2023).

International political environments also influence higher education internationalisation and multicultural education implementation. Changes in geopolitical relations, international policy environments, and global educational governance increasingly affect transnational academic cooperation and international programme sustainability (UNESCO, 2024). As a result, multicultural education implementation should be understood not only as an educational issue, but also as a governance issue shaped by broader structural and global conditions. Overall, the findings indicate that multicultural education outcomes are influenced not simply by internationalisation expansion itself, but by the interaction between institutional governance capacity, digital transformation, organisational adaptability, and implementation effectiveness. These findings further suggest that the implementation gap functions as a central mediating mechanism linking institutional conditions and multicultural education outcomes across Chinese universities.

Conclusion

This study examined the implementation of multicultural education within the context of higher education internationalisation in China. The findings indicate that multicultural education outcomes remain uneven across universities despite the continuous expansion of internationalisation policies and international academic cooperation programmes. Differences in institutional governance capacity, digital infrastructure, organisational adaptability, and internationalisation intensity significantly influence implementation effectiveness. The study further demonstrates that digital transformation increasingly functions as an important governance mechanism shaping curriculum delivery, intercultural learning interaction, and institutional coordination. However, uneven technological resources and governance capabilities continue to reinforce disparities between highly internationalised universities and resource-constrained institutions. As a result, the implementation gap emerges as a central mediating mechanism linking institutional conditions and multicultural education outcomes. In addition, international political environments and global educational transformation increasingly affect the sustainability of higher education internationalisation and multicultural education implementation. Therefore, multicultural education should be understood not only as an educational issue, but also as a governance issue shaped by broader structural and global conditions. This paper contributes to the literature by integrating implementation theory, governance analysis, and higher education internationalisation studies into a unified conceptual framework.

The findings further suggest that the implementation gap functions as a core mediating mechanism connecting institutional conditions and multicultural education implementation outcomes across Chinese universities. Future research may further examine empirical institutional cases, policy implementation processes, and the long-term influence of digital transformation on multicultural education outcomes across universities. Additional studies may also conduct more comprehensive longitudinal empirical investigations into multicultural education implementation within different higher education contexts.

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Navigating Language Deficiencies: Teachers' Perspectives on Tailoring English Modules for Tahfiz Students in Selangor

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Abstract
This study explores teachers' perspectives on the English language needs of Tahfiz students in Selangor, Malaysia, to inform the development of a specialised learning module. Utilising a qualitative approach within the Analysis phase of the ADDIE model, semi-structured interviews were conducted with educators from registered Tahfiz institutions. Findings reveal four primary themes: fundamental proficiency deficits where approximately 80% of students are classified as weak, the instrumental necessity of English as a lingua franca for global preaching (Da'wah), the urgent need for pedagogical customisation through kinaesthetic learning and Islamic content integration, and institutional barriers regarding teacher qualifications and time constraints. The data suggests that Tahfiz students possess a unique Islamic Drive, motivating them to master English for international religious outreach. The study concludes that an effective English module must bridge the gap between religious identity and linguistic competence by aligning with the students' cognitive styles. These insights provide the foundational elements required to design a module that empowers Tahfiz students to become well-rounded global leaders.

Keywords: English Language, Global Preachers, Islamic, Module, Tahfiz

Introduction

Tahfiz education, centred on the memorisation of the Holy Quran, remains one of the most significant traditional education systems in Malaysia and is experiencing a surge in popularity as parents seek to equip children with deep-rooted Islamic values. Despite the high religious expertise of these students, they are frequently perceived as being less motivated and having lower proficiency in the English language compared to their peers in mainstream education. This linguistic gap is particularly critical because English serves as the global lingua franca, and a lack of mastery limits the ability of future Muslim scholars to communicate Islamic teachings to international audiences (Abdullah et al., 2022).

In the contemporary landscape, the role of a Da'ie, or preacher, has evolved; they are no longer just local community leaders but are expected to function as global leaders. Previous research indicates that Tahfiz students possess a unique Islamic Drive, a motivational factor where the desire to spread Islamic knowledge acts as a primary catalyst for language acquisition (Abdullah et al., 2022). However, traditional English curricula might not to align with the specific cognitive styles, religious identities, and institutional schedules of Tahfiz schools.

Addressing these challenges requires a tailored approach to curriculum design (OECD, 2020). While student perspectives are valuable, teachers serve as the primary observers of the academic reality and the institutional barriers that define the learning environment. Therefore, this study aims to identify the specific elements required for a tailored English language module by exploring teachers' perspectives within the Analysis phase of the ADDIE instructional design model. By understanding these needs, the research seeks to develop a pedagogical framework that empowers Tahfiz students to become effective global communicators without compromising their religious foundations.

Review of Related Literature

The Evolution of Tahfiz Education in Malaysia

Historically, Islamic education in Malaysia was conducted in traditional surau or pondok systems, focusing primarily on the Quran and Islamic teachings. The first official Tahfiz institution was founded in 1966 by Tunku Abdul Rahman Putra al-Haj, inspired by global Islamic scholars (Wahida Ana Sophia Mohd Dain et al., 2026). In the contemporary era, these institutions are defined by their accountability in educating students to memorise the entire Al-Quran. Despite the surge in popularity and public attention, Tahfiz education is often viewed through a secular-oriented lens that lacks an emphasis on students' roles as international Da'ie, creating a barrier between their religious expertise and the wider world.

The Islamic Drive and L2 Motivation

Motivation serves as the initial engine and ongoing driving force for second language (L2) acquisition. For Tahfiz students, traditional motivation models are insufficient without considering religious identity. Recent studies identify an Islamic Drive, a specific motivational factor where students seek to learn English to spread Islamic knowledge and preach good values to global audiences. This drive is characterised by the belief that English is an international language essential for global purposes and for accessing a broader range of Islamic information. Consequently, successful L2 acquisition in this context is heavily dependent on aligning language learning with the students' ideal L2 self as a representative of Islam (Abdullah et al., 2022).

Challenges in English Proficiency among Religious Learners

Tahfiz students are frequently perceived as being less motivated and weaker in English language performance compared to mainstream students (Abdullah et al., 2022). This deficit is often linked to a lack of communicative confidence and a limited vocabulary range (Mohamad Kamal et al., 2024). Furthermore, the full-time nature of many Tahfiz schools often results in the exclusion of academic subjects, leaving little room for formal English instruction. There is a critical need to humanise English language education by integrating it with the socio-cultural and religious reality of these learners (Abdullah et al., 2022).

Instructional Design: The ADDIE Model

To bridge the gap between traditional memorisation and modern linguistic needs, the ADDIE model provides a robust framework for systematic curriculum development (Szabo, 2022). The model consists of five iterative phases: Analysis, Design, Development, Implementation, and Evaluation. The Analysis phase is particularly crucial as it identifies the fundamental needs, such as Islamic terminology and kinaesthetic learning preferences that ensure the resulting module is both complementary to Tahfiz education and sustainable for long-term use.

Objectives

This article are to examine the linguistic gap faced by Tahfiz students who excel in Quranic memorisation but often show lower proficiency in English compared to mainstream peers. It seeks to analyse the evolving role of Da'ie as global leaders who require strong English communication skills to share Islamic teachings internationally. The study aims to explore the Islamic Drive as a motivational factor for language acquisition, while recognizing that traditional English curricula may not align with Tahfiz students' cognitive styles, religious identities, and institutional schedules. Another objective is to address curriculum design challenges by tailoring English modules that respect religious foundations while enhancing global communication skills.

Furthermore, the research intends to investigate teachers' perspectives as primary observers of academic realities and institutional barriers, using the Analysis phase of the ADDIE instructional design model. It aims to identify specific elements required for a tailored English language module that empowers Tahfiz students. The study also seeks to develop a pedagogical framework that integrates Islamic values with effective language learning strategies. Ultimately, the objectives are to support Tahfiz students in becoming competent global communicators, reduce the linguistic gap, and ensure that their religious expertise is complemented by strong English proficiency without compromising their spiritual identity.

Methodology

Research Design

Being a part of a larger research project, this study adopts a mixed-methods research design framed within the ADDIE model (Analysis, Design, Development, Implementation, and Evaluation) to ensure a systematic approach to module development. This paper specifically reports on the Analysis phase, utilising a qualitative case study approach to explore the foundational needs of the target group. The qualitative data allows for a deep exploration of the participants lived experiences and institutional realities.

Research Setting and Participants

The empirical phase of this study was contextualized within registered Tahfiz institutions operating across the state of Selangor, Malaysia. This setting was strategically chosen due to the diverse landscape of Islamic education in the region. To gather rich, qualitative insights, the study employed a purposive sampling strategy to select the participants. The sample comprised Tahfiz educators who are actively engaged in the dual responsibilities of delivering daily academic curricula and religious instruction.

By focusing on teachers entrenched in this dual-role environment, the study secured a comprehensive and well-rounded perspective on contemporary pedagogical needs and classroom challenges. Furthermore, to ensure the credibility and suitability of the participants, candidates underwent a preliminary vetting process. The principals or administrative owners of the participating institutions, ensuring that the selected educators possessed the necessary experience and familiarity with the institutional framework to contribute meaningfully to the research, formally recommended them.

Data Collection

Data were primarily gathered through semi-structured focus group interviews and face-to-face interviews. An interview protocol adapted from Abdullah (2016) and Creswell (2008) was employed to structure the sessions and ensure consistency across interviews. The questions were specifically designed to probe four key areas, including (a) students' current English proficiency levels, (b) the relevance of English for the students' future roles, (c) preferred teaching and learning styles in the Tahfiz context and (d) institutional and logistical challenges.

Data Analysis

The interview data were analysed using a thematic analysis approach. The process involved several stages of data refinement:

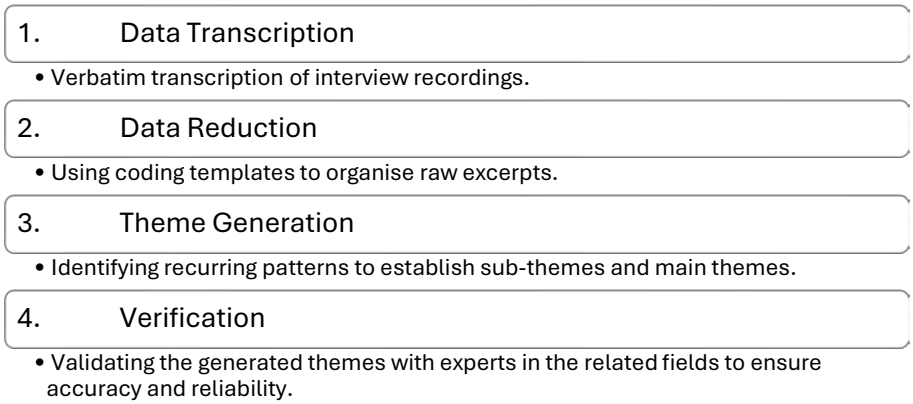

Figure 1. Process of Data Analysis

Ethical Considerations

The study was conducted under the approval of the Universiti Sains Islam Malaysia (USIM) research Ethics Committee. Participation was voluntary, and the anonymity of the teachers and their respective institutions was maintained throughout the reporting process.

Analysis

The Analysis phase of this study has provided a comprehensive understanding of the English language needs within the Tahfiz education sector in Selangor. The findings indicate that while Tahfiz students suffer from fundamental proficiency deficits, particularly in vocabulary and productive skills, there is a strong instrumental motivation to learn the language for global religious mission (Da'wah). Teachers explicitly identify the need for a curriculum that moves away from traditional academic structures toward kinaesthetic, active learning and the integration of Islamic content. However, institutional

barriers, including the lack of dual-qualified teachers and severe time constraints, remain significant hurdles.

Pedagogical and Policy Implications

- Module Content: The proposed module must prioritise Islamic terminology related to the Quran and Hadith to leverage the students' existing knowledge base.
- Instructional Approach: Lessons should focus on Performance-Based Assessments, such as English preaching (Bersyarah), which aligns with the students' future roles as global leaders.
- Flexible Delivery: Given the logistical challenge of mixed-ability classes, the module must include adaptations to cater to varying proficiency levels within a single classroom.

Policy Alignment: The development of this module directly supports the Malaysian Education Blueprint 2013-2025 regarding bilingual proficiency and the National Tahfiz Education Policy's goal of creating a curriculum compatible with mainstream education.

Following the ADDIE framework, the next stage of this research will involve the Design and Development phases. This includes the creation of a draft module that undergoes expert validation before being implemented in a pilot group. Subsequent evaluation using pre- and post-tests will be necessary to measure the module's effectiveness in improving communicative confidence among Tahfiz students.

Findings and Discussion

The thematic analysis of qualitative interviews conducted with Tahfiz educators yielded critical insights, revealing four predominant themes that collectively characterise the English language landscape within these religious institutions. These emergent themes are significant, as they establish the empirical foundation required to inform the Analysis phase of the ADDIE (Analysis, Design, Development, Implementation, and Evaluation) instructional design model.

Theme 1: Fundamental Proficiency Deficits and Skill Hierarchy

The first major theme identified centres on fundamental proficiency deficits and a distinct skill hierarchy among the student population. The gathered data explicitly highlights a critical, systemic gap between the rigid demands of the existing English curriculum and the actual language capabilities of the students. Teachers reported an overwhelmingly low baseline of English proficiency, with one teacher quantifying this crisis by noting that approximately 80% of their students are classified as weak language learners. A deeper examination of this deficiency reveals that a severe lack of basic vocabulary acts as the primary barrier to academic progression, severely affecting the students' ability to comprehend or process the language. Consequently, this lack of vocabulary directly impacts their productive skills, with teachers identifying speaking and grammar as the areas where students struggle most acutely. This inability to produce coherent language fosters a profound lack of confidence, ultimately paralysing students when they attempt basic communication. Furthermore, these foundational gaps run deep; teachers observed that fundamental grammatical structures, such as the proper application of basic copula verbs like 'is', 'are', and 'am', remain unmetered. Without these core linguistic building blocks, students are left fundamentally unequipped to construct even the simplest sentences, underscores the urgent need for targeted, remedial instructional design.

Theme 2: Instrumental English for Global Da'wah (Preaching)

The second theme that emerged from the thematic analysis centres on the concept of instrumental English for global Da'wah (Islamic preaching), highlighting that despite pervasive proficiency challenges, and educators identified a strong instrumental motivation for language acquisition among their students. This pronounced motivation closely aligns with the tenets of the Islamic Drive theory (Hazlina et al., 2022), which suggests that spiritual and religious duties can powerfully propel academic pursuit. Within this framework, English is not merely treated as an academic subject but is instead viewed as a vital lingua franca for international religious outreach and mission work within an increasingly interconnected global society. Consequently, the data indicates a pedagogical shift in focus from merely achieving passing grades on standardized exams toward fostering communicative confidence. The primary objective is to equip students with the linguistic tools necessary to speak persuasively with diverse populations, particularly non-Malay speakers and international communities. Furthermore, teachers observed a encouraging paradox in the classroom: despite the students' evident academic weaknesses in the language, they consistently display a genuine interest, enthusiasm, and intrinsic desire to master English, driven by this higher spiritual and practical purpose.

Theme 3: Curriculum Design and Pedagogical Customisation

The third theme underscores a critical need for strategic curriculum design and pedagogical customisation, with participating teachers strongly advocating for a definitive shift away from traditional, rote-learning methodologies. Instead, they emphasised the necessity of adopting instructional strategies that align more naturally with the unique cognitive profiles and learning habits of Tahfiz students. To achieve this, the data highlights a preference for kinaesthetic and active learning approaches, such as small-scale projects, interactive group work, and collaborative activities, over conventional, writing-heavy tasks that often fail to engage this student demographic. Furthermore, educators suggested that any newly developed instructional module should integrate localised Islamic content, including specialised Islamic terminology and Prophetic stories (*kisah Nabi*). This integration is deemed crucial for maintaining contextual relevance, as it directly bridges the gap between English language learning and the students' primary religious studies. Finally, to accurately gauge student progress, teachers recommended transitioning toward performance-based assessments. Rather than relying on traditional written examinations, these assessments should mimic real-world religious responsibilities, such as requiring students to deliver a formal sermon (*bersyarah*) in English, thereby reinforcing both practical language proficiency and ministerial competence.

Theme 4: Institutional and Resource Implementation Barriers

The fourth and final theme identifies the institutional and resource implementation barriers that create distinct logistical hurdles unique to the Tahfiz educational context. Foremost among these challenges is a structural dilemma termed the "Hafizah-Teacher" paradox. Participants highlighted the difficulty in recruiting English language teachers who concurrently possess formal religious qualifications, such as being a Hafizah (a female who has memorised the Quran). While this dual qualification is highly preferred by administrations to maintain institutional harmony and cultural alignment, it narrows the pool of available teaching talent. Furthermore, teachers face operational difficulties due to mixed-ability logistics within the classroom. Instructional delivery is frequently complicated by classes that combine students of vastly different ages and language proficiency levels, such as mixing 13- and 14-year-olds with much younger learners,

rendering standardised, one-size-fits-all lesson delivery virtually impossible. Compounding these classroom dynamics are severe curriculum time constraints. Because these institutions operate primarily as full-time Tahfiz schools, the academic schedule is dominated by Quranic memorisation, resulting in academic subjects like English being marginalised or, in some cases, entirely excluded from the daily timetable to prioritise religious mandates.

Discussion Summary

The findings from this study demonstrate that the Analysis phase confirms a pedagogical mismatch between standardised English language modules and the operational reality of Tahfiz institutions. While the "Islamic Drive" highlighted in contemporary literature is present among these students, its potential as a powerful motivational catalyst is hindered by the lack of foundational language proficiency. Consequently, the proposed instructional module cannot simply teach conventional English; instead, it must deliberately deliver language acquisition through the lens of Islamic identity to actively leverage and sustain student interest. Furthermore, to be successfully implemented within this unique educational ecosystem, the resulting module should be of a high degree of structural flexibility, allowing educators to accommodate mixed-ability student groups while operating efficiently within the strict, limited time constraints of a memorisation-heavy institutional schedule.

Conclusion

In conclusion, bridging the gap between religious identity and linguistic competence is essential for empowering the next generation of global Islamic leaders. By tailoring English language education to the specific socio-cultural and cognitive needs of Tahfiz students, institutions can produce well-rounded individuals capable of contributing meaningfully to the global community.

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Developing SCoRE Learning: Self-and Co-Regulated E-Portfolio Model for English in Vocational Health Promotion Programs

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Abstract

This study addresses the growing need for innovative English learning models in vocational health education that integrate digital technology, authentic communication, and learner autonomy. In Health Promotion programs, English instruction should not only develop general language proficiency but also prepare students to communicate effectively in professional healthcare and community contexts. This study aims to design and validate SCoRE (Self- and Co-Regulated E-Portfolio) Learning, an ESP- and OBE-oriented instructional model for vocational English learning. The study employed a Research and Development (R&D) approach using the ADDIE framework, focusing specifically on the Analysis, Design, and Development stages to produce and validate the initial prototype of the learning model prior to classroom implementation and large-scale evaluation. The research was conducted in three vocational higher education institutions offering Health Promotion programs. Data were collected through questionnaires, interviews, observations, focus group discussions, and expert validation sheets involving students, lecturers, and educational experts. The findings revealed that students experienced major difficulties in speaking, writing, vocabulary, and grammar, while current instructional practices remained largely teacher-cantered with limited formative feedback. Both students and lecturers demonstrated strong readiness for technology-integrated learning and expressed the need for authentic, collaborative, and reflective learning activities. The SCoRE model integrates Self-Regulated Learning (SRL) and Co-Regulated Learning (CoRL) principles through an e-portfolio system that facilitates reflection, peer feedback, authentic writing tasks, and professional health communication practices. Expert validation results indicated that the model was highly feasible in terms of content relevance, pedagogical design, technical usability, and language appropriateness, with average scores above 4.6 out of 5. The study concludes that SCoRE Learning provides a transformative framework for vocational English instruction by bridging digital learning, reflective practice, and workplace-oriented communication competence in health promotion education.

Keywords: Co-Regulated Learning, E-Portfolio, SCoRE Learning, Self-Regulated Learning, Vocational Education

Introduction

English instruction in vocational Health Promotion programs should not only develop students' general language proficiency but also prepare them to communicate effectively in professional healthcare and community contexts. In vocational education, English functions as a practical communication tool for delivering health information, conducting public campaigns, preparing educational media, and interacting with diverse communities. Therefore, English learning needs to align with the principles of English for Specific Purposes (ESP) and Outcome-Based Education (OBE), which emphasize authentic communication, contextualized learning outcomes, and workplace-oriented competencies. However, English instruction in many vocational health programs remains predominantly teacher-cantered and textbook-oriented, limiting opportunities for students to engage in reflective, collaborative, and authentic communication practices (Basturkmen, 2021; Hyland & Hamp-Lyons, 2002; Tarnopolsky, 2012). As a result, students often experience difficulties in productive skills such as speaking and writing, as well as in vocabulary and grammar application needed for professional communication.

One potential solution to this issue is the integration of Self-Regulated Learning (SRL) and Co-Regulated Learning (CoRL) into digital e-portfolio-based instruction. SRL encourages learners to plan, monitor, and evaluate their own learning processes (Zimmerman, 2000, 2008), while CoRL emphasizes peer interaction, collaboration, and shared responsibility in learning (A. Hadwin & Oshige, 2011; Panadero, Broadbent, et al., 2019). In language learning contexts, these approaches support learner autonomy, reflective practice, and collaborative knowledge construction (Allal, 2019; Lam, 2019; Saariaho et al., 2018; Schunk, 2011). Previous studies have demonstrated that e-portfolios can enhance writing performance, learner engagement, reflection, and authentic communication practices (Aygun & Aydin, 2016; Banhegyi & Fajt, 2024; Fathi & Rahimi, 2022; Kusuma et al., 2021; Sharma & Barrett, 2007). Nevertheless, many e-portfolio implementations still function primarily as repositories for assignments rather than as interactive pedagogical systems that support self- and co-regulated learning. To address this gap, the present study develops SCoRE (Self- and Co-Regulated E-Portfolio) Learning, an ESP- and OBE-oriented instructional model designed for English learning in vocational Health Promotion programs. The model integrates reflective learning, peer feedback, authentic communication tasks, and digital portfolio practices to support workplace-oriented communication competence in vocational health education.

Review of Related Literature

English for Specific Purposes (ESP) and Outcome-Based Education (OBE) in Vocational Education

English for Specific Purposes (ESP) emphasizes language learning that is closely connected to learners' academic and professional needs. In vocational education, ESP focuses on developing practical communication skills that support workplace performance and professional interaction (Basturkmen, 2021). In Health Promotion programs, students are required to communicate health information effectively through presentations, public campaigns, educational materials, and digital media. Therefore, English instruction should provide authentic and contextualized learning experiences that reflect real communication practices in healthcare and community settings. (Hyland & Hamp-Lyons, 2002) emphasize that ESP instruction becomes more meaningful when learning activities are directly linked to students' future professional contexts and communicative purposes.

The implementation of ESP in vocational education is closely related to Outcome-Based Education (OBE), which emphasizes measurable learning outcomes and competency achievement (Spady, 1994). OBE requires instructional activities, assessments, and learning materials to be aligned with expected competencies and workplace demands. In vocational Health Promotion programs, this means that English learning should not only focus on linguistic knowledge but also on students' ability to perform authentic communication tasks relevant to public health contexts. Accordingly, integrating ESP and OBE principles can help vocational students develop workplace-oriented communication competence that is both functional and professionally relevant.

Self-Regulated Learning (SRL) and Co-Regulated Learning (CoRL)

Self-Regulated Learning (SRL) refers to learners' ability to actively control and manage their cognitive, motivational, and behavioural learning processes through planning, monitoring, and self-evaluation (Zimmerman, 2000, 2008). SRL is considered important in language learning because it encourages learner autonomy, reflective thinking, and responsibility for learning progress. Students who apply SRL strategies are generally more capable of identifying their weaknesses, setting learning goals, and revising their work independently (Schunk, 2011). In writing instruction, SRL supports students in managing the recursive processes of drafting, revising, and editing.

In addition to self-regulation, collaborative learning processes are also essential in language education. Co-Regulated Learning (CoRL) emphasizes shared regulation through peer interaction, collaboration, and social support during learning activities (Hadwin et al., 2018). Through peer feedback, discussion, and collaborative revision, students learn to negotiate meaning, evaluate ideas, and improve their communication performance together. (Panadero, Lipnevich, et al., 2019) explain that co-regulation enables students to internalize assessment strategies and reflective practices through interaction with peers and teachers. Similarly, Lam (2019) argues that effective co-regulated learning depends on classroom interaction patterns, collaborative activities, and supportive instructional design. Therefore, integrating SRL and CoRL can create a more reflective, collaborative, and learner-cantered environment in vocational English classrooms.

E-Portfolio in Language Learning

E-portfolios have been widely recognized as effective tools for supporting reflective and technology-integrated learning. Sharma & Barrett (2007) explains that e-portfolios facilitate documentation, reflection, self-assessment, and continuous learning development. In language learning contexts, e-portfolios enable students to collect assignments, monitor revisions, receive feedback, and demonstrate learning progress over time. Unlike conventional assessment systems, e-portfolios encourage students to actively participate in evaluating and improving their own work. Previous studies have shown positive impacts of e-portfolios on language learning outcomes. Aygun and Aydin (2016) found that e-portfolios improve students' writing skills by facilitating feedback, revision, and multimedia integration. Kusuma et al., (2021) further reported that e-portfolios enhanced learner engagement in speaking courses during online learning contexts. Similarly, Fathi and Rahimi (2022) demonstrated that collaborative electronic writing portfolios significantly improved students' writing performance and peer interaction. More recently, Banhegyi and Fajt (2024) highlighted that portfolio-based learning promotes authenticity, learner reflection, and professional preparedness in ESP instruction. Despite these advantages, many e-portfolio implementations still function

mainly as assignment repositories rather than as pedagogical systems integrating reflective learning, collaboration, and learner regulation. Therefore, there remains a need to develop e-portfolio-based instructional models that integrate SRL and CoRL principles to support authentic and workplace-oriented English learning in vocational Health Promotion programs.

Research Questions

To address this gap, this study develops SCoRE (Self- and Co-Regulated E-Portfolio) Learning, an ESP- and OBE-oriented instructional model for English learning in vocational Health Promotion programs. The model integrates reflective learning, peer feedback, authentic communication tasks, and professional health promotion contexts through a digital e-portfolio system. This study employs a Research and Development (R&D) approach using the ADDIE framework, focusing on the Analysis, Design, and Development stages to produce and validate the initial prototype of the model.

Specifically, this study addresses the following research questions:

1. What are the English learning needs of Health Promotion students?
2. How is the SCoRE Learning model developed for vocational Health Promotion programs?
3. How are ESP, OBE, SRL, and CoRL principles embodied within the SCoRE Learning model?

Methodology

Research Design

This study employed a Research and Development (R&D) approach to develop and validate SCoRE (Self- and Co-Regulated E-Portfolio) Learning for English instruction in vocational Health Promotion programs. The study adopted the ADDIE instructional design framework consisting of Analysis, Design, Development, Implementation, and Evaluation phases (Branch, 2009). However, this research was limited to the first three stages—Analysis, Design, and Development (ADD)—to produce and validate the initial prototype prior to classroom implementation. The R&D approach was selected because it enables systematic development of educational products grounded in theoretical foundations, contextual needs, and expert validation (Gall et al., 2003).

Research Context and Participants

The study was conducted in three vocational higher education institutions offering Health Promotion programs: Faculty of Vocational Studies UNY, STIKES Surya Global, and POLTEKKES UMMI KHASANAH. Participants included students and English lecturers selected purposively to provide information regarding learning difficulties, instructional practices, communication needs, and readiness for e-portfolio integration. In the validation stage, four experts in Health Promotion, English language teaching, educational technology, and instructional design were involved based on their expertise and publication background.

Data Collection and Instruments

This study employed both qualitative and quantitative data collection techniques. Qualitative data were obtained through observations, interviews, focus group discussions (FGDs), and document analysis to explore students' learning needs, classroom practices, and challenges in vocational English instruction. Quantitative data were collected using

needs analysis questionnaires and expert validation sheets evaluating the model's content relevance, pedagogical feasibility, technical usability, and language appropriateness.
The instruments included questionnaires, interview guidelines, observation sheets, and expert validation forms. The instruments were designed based on ESP, OBE, SRL, and CoRL principles and were reviewed by experts prior to use to ensure content validity.

Research Procedures

The study consisted of three stages. First, the analysis stage identified students' English learning needs, instructional challenges, and technological readiness for e-portfolio learning through surveys, interviews, observations, and document analysis. Second, the design stage formulated the SCoRE Learning framework by integrating ESP, Outcome-Based Education (OBE), Self-Regulated Learning (SRL), and Co-Regulated Learning (CoRL) principles into authentic and reflective learning activities. Third, the development stage produced the prototype consisting of an instructional guide, e-portfolio structure, and ESP-based learning tasks. The prototype was subsequently validated by experts focusing on content relevance, pedagogical feasibility, technical usability, and language appropriateness.

Analysis

Qualitative data from interviews, observations, FGDs, and expert comments were analysed interactively through data condensation, data display, and conclusion drawing following Miles et al. (2014). Meanwhile, quantitative data from questionnaires and expert validation sheets were analysed descriptively using mean scores and percentage distributions (Creswell & Creswell, 2018). The validation results were categorized into validity levels ranging from low to very high validity based on predetermined score conversion criteria. Qualitative feedback from experts was further used to revise and refine the SCoRE Learning model.

Needs Analysis

The needs analysis was conducted through questionnaires, interviews, observations, and document analysis to identify students' English learning difficulties, instructional practices, vocational communication needs, and readiness for e-portfolio-based learning in Health Promotion programs. The findings revealed several challenges that support the development of SCoRE (Self- and Co-Regulated E-Portfolio) Learning.

Students' English Learning Difficulties

The findings indicated that students experienced considerable difficulties in productive language skills, particularly speaking (41%) and writing (32%). The major contributing factors included limited vocabulary mastery (25%), insufficient grammar control (22%), and lack of writing practice. Interview data further revealed that students frequently relied on machine translation tools and encountered difficulties expressing ideas accurately and coherently in English. One student stated, "Vocabulary is the barrier in developing students' writing skills," while another explained "students still depend on Google Translate." These findings suggest the need for a learning model that facilitates vocabulary development, contextual grammar application, and continuous writing practice through reflective and feedback-oriented activities.

Teachers' Instructional Practices

The results showed that English instruction remained predominantly teacher-centred. Lecturers generally relied on lectures, slide presentations, and assignment submission

through digital platforms such as Google Classroom. However, these platforms mainly functioned as repositories rather than interactive learning environments. Opportunities for formative feedback, peer collaboration, and iterative writing activities were still limited due to restricted instructional time and block scheduling systems. Interview findings also indicated that learning activities were dominated by lecturer explanations followed by assignment completion and final assessment. Consequently, current instructional practices have not adequately supported self-regulated or collaborative learning processes in vocational English classrooms.

Vocational Communication Needs

Both students and lecturers identified speaking and writing as the most essential communication skills for vocational purposes, with 76% of respondents emphasizing the importance of productive skills in workplace communication. English was considered important for delivering health information, conducting presentations, developing health promotion media, and engaging in public communication. Students emphasized the importance of creating posters, leaflets, blogs, and digital campaign content, while lecturers highlighted presentation and reporting skills as essential workplace competencies. These findings indicate that vocational English learning should prioritize authentic and workplace-oriented communication tasks relevant to health promotion contexts.

Technological Readiness for E-Portfolio Learning

The findings also demonstrated strong readiness for technology-integrated learning. Most students (86%) agreed that English learning should involve staged writing processes such as brainstorming, drafting, revising, and publishing. In addition, 53% of the respondents preferred website-based e-portfolio systems that enable assignment submission, feedback exchange, progress monitoring, and reflective learning. Both students and lecturers viewed e-portfolios positively because they support documentation of learning progress and continuous improvement. One student stated, “students must know their own progress, not only lecturers,” indicating the importance of reflective and self-monitoring learning environments.

Table 01: Summary of Needs Analysis Findings and Implications for SCoRE Learning

Aspect	Key Findings	Implications for SCoRE Learning
Students’ English learning difficulties	Students experienced difficulties in speaking (41%), writing (32%), vocabulary mastery (25%), and grammar application (22%). Many students also relied heavily on machine translation tools.	The model should support continuous writing practice, vocabulary enrichment, contextual grammar use, and reflective learning processes.
Instructional practices	English instruction remained predominantly teacher-centered with limited formative feedback, peer interaction, and collaborative learning activities.	The model should integrate self-regulated and co-regulated learning through peer feedback, reflection, and collaborative tasks.
Vocational communication needs	Most respondents (76%) emphasized the importance of speaking and writing for presentations, health campaigns, digital content creation, and public communication.	Learning activities should emphasize authentic ESP-based communication tasks relevant to workplace practices.
Technological readiness	Most students (86%) supported staged writing activities, while 53% preferred website-based e-portfolio learning systems for feedback and progress monitoring.	E-portfolio integration is pedagogically and technologically feasible to

		support reflective and interactive learning.

Findings and Discussion

Overall, the needs analysis revealed a mismatch between current instructional practices and the communicative demands of vocational Health Promotion programs. While students require authentic, collaborative, and reflective English learning experiences, classroom practices remain largely instructor-centered and minimally interactive. At the same time, the positive perception toward digital learning environments indicates strong pedagogical and technological support for developing SCoRE Learning as an ESP- and OBE-oriented instructional model for vocational English education.

Design of SCoRE Learning

The design stage aimed to transform the results of the needs analysis into SCoRE (Self- and Co-Regulated E-Portfolio) Learning, an ESP- and OBE-oriented instructional model for vocational English learning in Health Promotion programs. The model was designed to integrate authentic communication tasks, reflective learning, and digital collaboration through an e-portfolio system.

Alignment with ESP and OBE Principles

The learning objectives were formulated based on ESP and Outcome-Based Education (OBE) principles, emphasizing measurable competencies in attitude, knowledge, and skills. The model focused on vocationally relevant communication abilities, including producing health promotion materials such as posters, pamphlets, digital campaigns, and public information texts. Learning activities, assessments, and digital tools were aligned with clearly defined outcomes to ensure that students could demonstrate workplace-oriented communication competence.

Integration of Self-Regulated and Co-Regulated Learning

SCoRE Learning integrates Self-Regulated Learning (SRL) and Co-Regulated Learning (CoRL) throughout the instructional process. Students are encouraged to plan, monitor, and evaluate their learning through individual e-portfolio activities, while peer feedback, collaborative drafting, and group reflection facilitate co-regulated learning. The model adopts the IPCR cycle (Introduction–Practice–Composition–Reflection) as its instructional framework. Through this cycle, students gradually develop responsibility for their learning while engaging in collaborative support and reflective revision processes.

Authentic and Reflective Learning Activities

The model incorporates authentic vocational tasks that reflect real communication practices in Health Promotion contexts. Students engage in activities such as composing health campaign posters, writing blog articles, preparing public health information materials, and developing digital promotional content. Reflection and formative feedback are embedded within each learning cycle through e-portfolio journals, peer review, and revision activities. These processes promote learner autonomy, collaboration, and metacognitive awareness.

Digital Learning Flow and Participant Roles

The instructional flow is organized through the IPCR framework supported by the E-Portfolio 2.0 platform. The platform enables students to upload assignments, monitor progress, receive feedback, and document learning development. In this model, lecturers function as facilitators and feedback providers, while students act as active learners, collaborators, and self-regulated writers responsible for their learning progress.

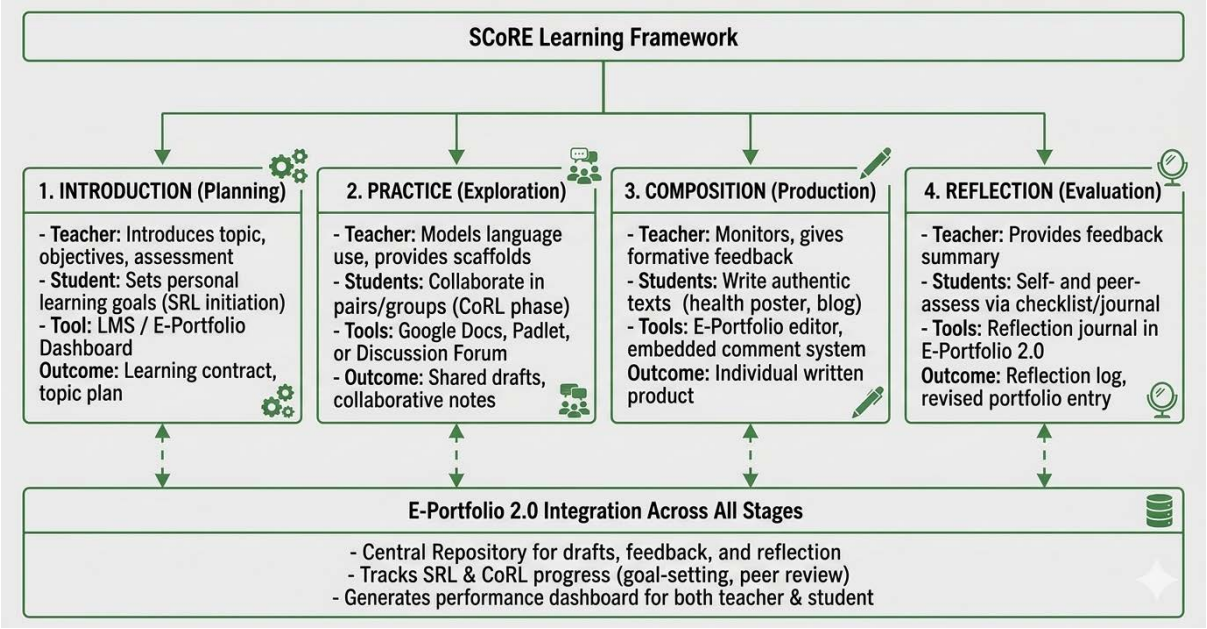

Figure 1. Instructional Design of SCoRE Learning

Overall, the design stage demonstrates that SCoRE Learning provides a coherent pedagogical framework integrating ESP, OBE, SRL, and CoRL principles into vocational English instruction. The model emphasizes authentic communication, reflective learning, collaborative engagement, and digital portfolio practices to support students' professional communication competence in Health Promotion programs.

Development and Expert Validation

The development stage focused on producing and validating the prototype of SCoRE (Self- and Co-Regulated E-Portfolio) Learning. The prototype consisted of the instructional framework, e-portfolio structure, learning activities, and ESP-based materials for vocational Health Promotion programs. Expert validation results indicated that the model was highly feasible across four aspects: content relevance, pedagogical feasibility, technical design and usability, and language appropriateness.

Content Relevance

Experts confirmed that the model strongly aligns with ESP and OBE principles, particularly in vocational and health-related communication contexts. The learning tasks, such as creating persuasive health messages, public announcements, posters, and digital campaign materials, were considered relevant to authentic workplace communication needs. The validation results showed high feasibility scores, with mean values ranging from 4.58 to 4.75. Experts also emphasized that the model effectively connects English learning with professional communication practices in Health Promotion programs.

Pedagogical Feasibility
The model was positively evaluated for integrating Self-Regulated Learning (SRL) and Co-Regulated Learning (CoRL) principles into the instructional cycle. Through the IPCR framework (Introduction–Practice–Composition–Reflection), students are encouraged to plan, monitor, revise, and reflect on their learning processes while engaging in peer feedback and collaborative activities. Experts noted that these features promote learner autonomy, reflective learning, and active participation. The pedagogical aspect achieved a mean score of 4.33, categorized as Highly Feasible.

Technical Design and Usability
The E-Portfolio 2.0 platform was evaluated positively in terms of accessibility, organization, and usability. Experts highlighted the platform's clear layout, intuitive navigation, and effective integration of multimedia resources that support assignment submission, progress monitoring, and feedback exchange. The technical feasibility scores ranged from 4.40 to 4.67, indicating that the platform is suitable for supporting independent and collaborative learning in vocational English instruction.

Language Appropriateness
The language used in the instructional materials and learning guides was considered clear, contextualized, and appropriate for vocational undergraduate students. Experts stated that the materials successfully balanced professional English use with comprehensibility for learners at different proficiency levels. The language aspect received mean scores ranging from 4.60 to 5.00, categorized as Highly Feasible.

Table 2: Summary of Expert Validation Results

Validation Aspect	Mean Score	Category
Content relevance	04.58	Highly Feasible
Pedagogical feasibility	04.33	Highly Feasible
Technical design and usability	04.54	Highly Feasible
Language appropriateness	4,80	Highly Feasible

Overall, the validation results demonstrate that SCoRE Learning is theoretically grounded, pedagogically coherent, technologically feasible, and contextually appropriate for vocational English learning in Health Promotion programs. Minor revisions suggested by reviewers included improving technical guidance and enhancing visual references; however, these recommendations did not affect the overall feasibility of the model. Therefore, the findings confirm that SCoRE Learning is ready for limited classroom implementation and further evaluation in future studies. (

Table 1. Independent Sample Size Effects.

		Standardizer[a]	Point Estimate	95% Confidence Interval	
				Lower	Upper
	Cohen's d	.996	0.019	-0.516	0.555

AI-based tools improve the overall quality of language teaching/learning.	Hedges' correction	1.010	0.019	-0.509	0.547
	Glass's delta	.793	0.024	-0.511	0.560
AI can help provide personalized learning experiences for students.	Cohen's d	1.042	-0.399	-0.938	0.143
	Hedges' correction	1.056	-0.394	-0.925	0.141
	Glass's delta	1.167	-0.356	-0.899	0.195

a. The denominator used in estimating the effect sizes.
Cohen's d uses the pooled standard deviation.
Hedges' correction uses the pooled standard deviation, plus a correction factor.
Glass's delta uses the sample standard deviation of the control group.

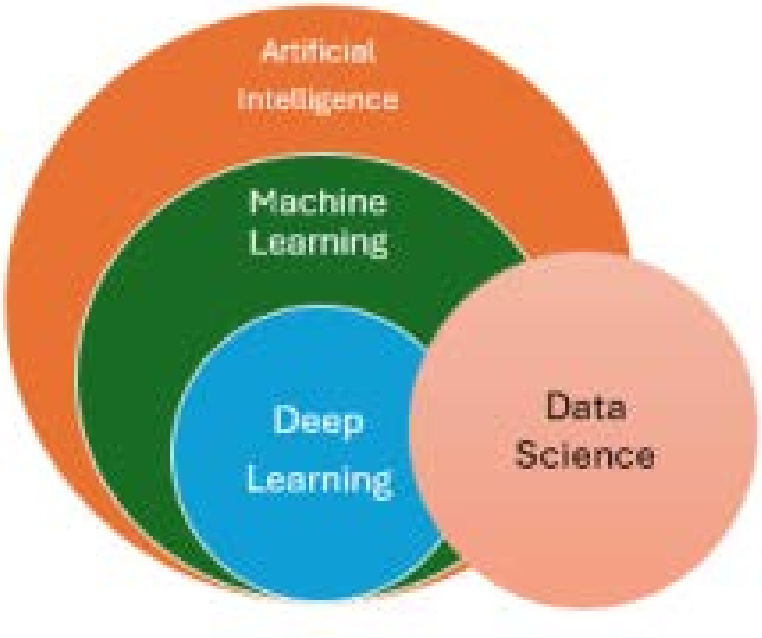

Figure 1: Subsets of AI

Conclusion

According to the World Bank (2020) and the University Grants Commission (2023), only a small proportion of Sri Lankan students' progress to higher education, reflecting the highly competitive and limited nature of the system. Slow learners in 1C schools face added barriers such as poor academic support, socio-economic challenges, and lack of parental involvement (UNESCO, 2021; Iloanya, 2019). These schools often lack science streams and access to modern learning technologies, limiting inclusive teaching approaches (World Bank, 2020). Traditional, teacher cantered methods dominate, leading to disengagement and high dropout rates

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The Effectiveness of Using Technology in English Language Classrooms among Secondary Level Students in Nukus, Uzbekistan

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Abstract

This study investigates the impact of technology integration on English language learning among secondary students in Nukus, Uzbekistan. Using a quasi-experimental one-group pre/post-test design, 40 Grade 9 students received instruction supplemented by digital tools such as Duolingo, YouTube, Kahoot, and Google Docs over an 8-week period. Results revealed a statistically significant improvement in English proficiency across reading, writing, speaking, and listening. Skill-specific analyses showed strongest gains in listening and vocabulary. The study also found increased student motivation and out-of-class language engagement. Limitations include the lack of a control group and short intervention duration. These findings underscore the need for further research, enhanced pedagogical training, and equity-focused implementation strategies to support technology-integrated language learning.

Keywords: Computer-Assisted Language Learning, EFL Classrooms, Language Proficiency, Secondary Education, Technology Integration

Introduction

Sustainable In the 21st century, the integration of technology into educational settings has transformed from a progressive luxury to an essential foundation of language learning environments (OECD, 2001). Traditional instructional configurations that prioritize static textbooks and teacher-centred lecturing frequently struggle to meet the communicative demands required for global modernization. Within non-native environments, students face significant modern challenges acquiring English fluency due to limited exposure outside formal school contexts (Nunan, 2003). Computer-Assisted Language Learning (CALL) environments mitigate these gaps by transitioning passive language instruction into interactive, communicative frameworks (Warschauer & Healey, 1998).

The educational ecosystem of Uzbekistan is currently experiencing comprehensive systemic reforms aimed at digitalizing local schools and institutional frameworks (Tursunov, 2023). Despite strong national initiatives, secondary school English as a Foreign Language (EFL) pipelines face distinct regional constraints. Urban centres often enjoy better resource allocations, leaving regional municipal institutions in areas like Nukus encountering specific challenges including baseline digital infrastructure and access gaps (Saidova, 2022). While theoretical models suggest that introducing digital media elevates regional performance, empirical verification across regional secondary classrooms remains sparse.

By applying Self-Determination Theory, researchers state that digital systems cultivate intrinsic motivation by establishing higher feelings of competence, learner autonomy, and peer-to-peer engagement (Deci & Ryan, 1982). Furthermore, Sociocultural Theory posits that tech-mediated environments foster a digital Zone of Proximal Development via scaffolding tools like immediate corrective software algorithms and group interactions (Vygotsky, 1978). This research addresses regional gaps by providing concrete, local data on tech-enhanced language performance. The target objective of this study was to evaluate the absolute instructional effectiveness of specific digital tools on English language proficiency and student motivation profiles among Grade 9 students within a secondary school in Nukus, Uzbekistan.

Review of Related Literature

The literature highlights the transformative role of digital technologies in English as a Foreign Language (EFL) learning, particularly in contexts with limited exposure outside classrooms. Early work on intrinsic motivation and self-determination (Deci & Ryan, 1982) established that learner autonomy and competence are critical for sustained engagement, while Sociocultural Theory (Vygotsky, 1978) emphasized scaffolding and peer interaction as essential for language development. Within this framework, Computer-Assisted Language Learning (CALL) emerged as a major innovation, shifting instruction from passive textbook-based learning to interactive, communicative environments (Warschauer & Healey, 1998).

In the Asia-Pacific region, the global spread of English has reshaped educational policies, requiring more communicative and technology-driven approaches (Nunan, 2003). The OECD (2001) report underscored the importance of ICT integration in schools, framing digital tools as essential rather than optional. In Uzbekistan, systemic reforms have prioritized digitalization, yet regional disparities remain. Urban schools benefit from stronger infrastructure, while municipal institutions in areas like Nukus face challenges in access and implementation (Tursunov, 2023; Saidova, 2022). Empirical studies show that digital media enhances student motivation in urban classrooms, but rural contexts require targeted strategies to overcome resource gaps.

Overall, the literature suggests that digital tools can significantly improve EFL performance by fostering motivation, autonomy, and communicative competence. However, successful implementation depends on addressing institutional inequalities and aligning technology use with pedagogical frameworks that emphasize both self-determination and sociocultural interaction. This balance is crucial for ensuring equitable and effective language learning outcomes in Uzbekistan and beyond.

Objectives

This article are to evaluate the instructional effectiveness of specific digital tools on English language proficiency among Grade 9 students in Nukus, Uzbekistan. It seeks to examine how technology integration transforms traditional teacher-cantered instruction into interactive, communicative frameworks. The study aims to address regional constraints by analysing the impact of limited infrastructure and access gaps in municipal schools compared to urban centres. Another objective is to apply Self-Determination Theory to explore how digital systems foster intrinsic motivation through competence, autonomy, and peer engagement.

The research intends to use Sociocultural Theory to investigate how tech-mediated environments create a digital Zone of Proximal Development through scaffolding and group interaction. It aims to provide empirical data on the effectiveness of digital media in regional secondary classrooms, filling gaps in existing theoretical models. The study also seeks to analyse student motivation profiles in relation to digital learning tools and to assess the role of national reforms in shaping classroom practices. Ultimately, the objectives are to contribute to educational policy by offering context-specific insights into how digital transformation can enhance language learning outcomes, reduce disparities between urban and regional schools, and strengthen the overall effectiveness of EFL instruction in Uzbekistan.

Methodology

This research employed a quantitative quasi-experimental design using a single-group pre-test and post-test architecture monitored over a continuous 8-week period. The experimental cohort consisted of 40 Grade 9 secondary school students (22 female, 18 male, average age 14.5 years) drawn via purposeful sample distribution from a public school located in Nukus, Karakalpakstan.

The instructional intervention directly incorporated a structured curriculum featuring specific digital media solutions selected to reinforce distinct linguistic proficiencies. Grammar and vocabulary tracking were managed via daily personalized assignments on the Duolingo platform. Listening comprehension modules were supplemented utilizing contextual educational videos via YouTube (10 minutes per session). Interactive assessment frameworks were administered through gamified, bi-weekly competitive check-ins using Kahoot. Collaborative writing practical were developed synchronously via shared digital workspaces using Google Docs. Linguistic benchmarks were assessed utilizing standardized diagnostic instruments covering listening, reading, writing, and speaking proficiencies before and after the intervention.

Linguistic score datasets were aggregated, converted into percentage scores, and analysed using IBM SPSS Statistics software. Due to the longitudinal tracking configuration of a single experimental sample, paired-samples t-tests were used to measure score variations before and after tech deployment. Statistical significance was verified relative to a threshold of $p < 0.05$.

Findings and Discussion

Empirical metrics compiled at the conclusion of the 8-week instructional block showed clear performance changes across all diagnostic parameters. The cumulative mean score improved from a baseline pre-test value of 58.4% to a post-test value of 73.2%. To evaluate individual performance categories, comprehensive metrics are structured inside the summary table below.

Table 1. Skills-Specific Pre-Test and Post-Test Language Proficiency Metrics

Language Skill Profile	Baseline Pre-Test Mean (%)	Post-Intervention Mean (%)	Net Score Change (%)	Paired t-test (t)	Significance (p)
Listening Skills	52.3 ± 1.4	71.8 ± 1.2	+19.5	6.42	< 0.01

Vocabulary / Grammar	54.1 ± 1.1	72.4 ± 0.9	+18.3	5.89	< 0.01
Reading Comprehension	64.5 ± 1.6	76.2 ± 1.1	+11.7	4.15	< 0.05
Writing Production	56.8 ± 1.3	67.5 ± 1.5	+10.7	3.98	< 0.05
Verbal Speaking	64.3 ± 1.2	78.1 ± 1.0	+13.8	4.81	< 0.05

Source: Aggregated sample datasets collected over 8 weeks (n = 40)

The performance differences observed in Table 1 confirm that targeted tech integration yields variable results depending on the specific language domain. The highest net improvement was achieved in Listening Skills (+19.5%, $t = 6.42$, $p < 0.01$). This confirms that direct, repeated contact with authentic online audio materials lowers affective filters and enhances sound-to-script decoding capabilities.

Vocabulary and Grammar proficiencies also showed strong improvement (+18.3%), demonstrating the benefits of automated spaced-repetition loops and immediate platform feedback over mechanical worksheet drilling. Conversely, writing production metrics changed less drastically (+10.7%), showing that though digital peer editing via Google Docs optimizes structural planning, forming complex syntax requires continuous teacher scaffolding. Surveys administered after the intervention showed shifts in motivation. Students highlighted that the gamified mechanics of Kahoot and real-time score analytics boosted their intrinsic motivation to study outside school hours. This dynamic fits Self-Determination theory, as interactive digital elements empower self-directed learning and autonomy (Deci & Ryan, 1982).

Conclusion

The implementation of educational technology within Grade 9 EFL classrooms in Nukus, Uzbekistan, led to a statistically significant improvement across all assessed core language competencies. The strongest experimental improvements occurred within listening and vocabulary channels, driven by daily exposure to multimedia scaffolding and gamified reinforcement systems. Furthermore, these digital workspaces improved active out-of-class engagement and autonomous collaboration.

While limited by its single-group configuration and short timeline, this study confirms that integrated CALL frameworks can improve educational delivery in regional Uzbek secondary schools. Future policy initiatives should focus on reducing regional digital equity gaps and providing teachers with systematic pedagogical training on tech integration.

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Transparency Mechanisms and the Integrity of Education Policy Implementation in Mauritius

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Abstract

The study examined the relationship between transparency mechanisms and the integrity of education policy implementation in Mauritius. It was guided by Principal-Agent Theory, Good Governance Theory, and Institutional Theory. It used a mixed methods design including a quantitative survey of 333 education stakeholders and semi-structured interviews. Quantitative data were analysed using descriptive statistics and Structural Equation Modelling. The findings showed generally positive perceptions of transparency, accountability, and compliance with policies. The SEM results indicated that transparency had the strongest positive effect on policy implementation integrity ($\beta = 0.432$, $p < 0.001$), followed by ethical governance ($\beta = 0.410$, $p < 0.001$), accountability structures ($\beta = 0.387$, $p < 0.001$), and policy alignment ($\beta = 0.298$, $p = 0.001$). The indirect effects of transparency ($\beta = 0.162$, $p = 0.001$) and accountability ($\beta = 0.138$, $p = 0.008$) were significant as per mediation analysis. Qualitative findings confirmed the relevance of institutional culture and stakeholder participation. The study concluded that transparency greatly improves the integrity of policy, especially when combined with strong accountability and ethical governance structures. It recommended strengthening digital transparency platforms, enforcement mechanisms, and participatory governance structures. Future research should consider contextual factors influencing the operationalisation of global governance standards in Mauritius' education sector over time.

Keywords: Accountability, Education Policy Implementation, Integrity, Mauritius, Transparency Mechanisms

Introduction

Tahfiz Education is generally accepted as a strategic sector for national development because of its major contribution to human capital formation, social mobility, economic productivity, and sustainable national growth. Governments worldwide continue to invest heavily in educational reforms to improve access, quality, equity, and learning outcomes. But the success of such reform is not simply a matter of policy formulation, but also of the integrity and transparency of policy implementation processes. International organisations such as UNESCO (2023) and OECD (2021) emphasise transparency, accountability, ethical conduct, and stakeholder participation as key principles in effective educational governance. These principles help to ensure that educational resources are used efficiently, that policy goals are met, and that public confidence in government institutions is improved.

Globally, there is increasing concern about the gaps in policy implementation, weak monitoring systems, mismanagement of resources, and inadequate institutional accountability in the education sector. While many countries have embraced reforms that are aligned with international standards, implementation challenges often curtail the realisation of intended outcomes (Hallak & Poisson, 2020). Transparency mechanisms have thus become important governance tools to promote accountability, enhance institutional effectiveness, reduce opportunities for maladministration, and build public trust in education systems.

In this context, Mauritius provides a significant case for study. Since its independence in 1968, Mauritius has undertaken major reforms in the education sector to improve access, quality, and support national development. The country has moved from a colonial system of education to a national system of education supported by modern governance structures, curriculum reforms, teacher development initiatives, and investment in technical and vocational education (MoETEST, 2022). These accomplishments have placed Mauritius among the top-performing educational countries in Africa and a recognised model among Small Island Developing States (SIDS).

Notwithstanding these achievements, questions about how well transparency systems maintain integrity throughout the policy implementation process still need to be answered. Scholars and policymakers continue to focus on issues of accountability, stakeholder involvement, monitoring efficacy, and fair resource distribution (UNICEF, 2020). Additionally, there is no actual data on how transparency techniques affect the integrity of Mauritius' execution of education policy. With a focus on accountability frameworks, stakeholder participation, and governance procedures, this study aims to investigate the connection between transparency measures and the integrity of education policy implementation in Mauritius. The results should help achieve Sustainable Development Goals 4 and 16, add to the body of knowledge on educational governance, and guide policy changes.

Review of Related Literature

The empirical review of the literature offers an analysis of previous research on the integrity of education policy implementation within public sector governance and transparency procedures. It looks at important ideas, governance procedures, stakeholder participation, implementation procedures, and current issues. The review highlights further information gaps and lays the empirical groundwork for examining the ways in which transparency mechanisms affect the efficacy and integrity of Mauritius' execution of education policies.

Concept of Transparency in Public Administration

Transparency has emerged as a key tenet of modern public government and administration. According to recent research (OECD, 2023; United Nations, 2024), transparency is the degree to which government institutions make information, decisions, processes, and results available to stakeholders and the general public. Informational, procedural, financial, and decision-making openness are only a few of the many aspects of transparency. When taken as a whole, these aspects allow individuals to evaluate public institutions' performance and comprehend governmental activities.

One essential element of transparency is the disclosure of information. Open governance frameworks, according to UNESCO (2023), promote public institutions to provide

information about policies, budgets, programs, and implementation outcomes in a timely, accurate, and easily available manner. Public trust in governance procedures is increased, and informed stakeholder involvement is made easier by such transparency. Through online portals, open-data platforms, and electronic reporting systems, digital technologies have further increased the options for information exchange.

Transparency serves as a crucial technique for encouraging accountability, according to empirical data. According to the World Bank (2024), transparent governance systems increase institutional responsiveness, strengthen supervision, and decrease potential for corruption. Transparency in educational administration allows stakeholders to keep an eye on how policies are being implemented, how resources are being allocated, and how students are doing. Transparent administrative methods have been shown to promote policy compliance, improve service delivery, and boost public trust in both developed and developing nations (UNDP, 2023; OECD, 2023). As a result, openness continues to be a crucial factor in determining both sustainable institutional performance and efficient public sector governance.

Integrity in Policy Implementation

Integrity is essential to both successful policy implementation and efficient public sector governance. Integrity is defined in contemporary governance literature as following legal requirements, professional standards, ethical principles, and public service ideals when implementing government programs (OECD, 2024). In order to be considered honest, fair, and consistent, public leaders and institutions must put the public interest ahead of their own political or personal agendas.

Building public trust in political institutions starts with ethical governance. Integrity in public administration fosters legitimacy, accountability, and citizen confidence, according to the United Nations (2024). Since implementing policies frequently requires significant public resources, stakeholder participation, and long-term developmental objectives, educational institutions are especially dependent on honesty. Stakeholders are more likely to view educational innovations as legitimate and helpful when implementation procedures are marked by moral behaviour and openness.

There is a high correlation between implementation success and transparency, according to additional research. Transparency improves accountability systems, makes it easier to monitor implementation efforts, and deters misbehaviour or poor resource management (World Bank, 2024). According to OECD (2024), integrity in educational systems supports better learning results, fair resource allocation, and efficient policy implementation. Therefore, empirical research has shown that integrity plays a crucial role in determining whether public policy efforts succeed or fail, especially in areas where the quality of governance has a direct impact on societal progress and citizen welfare. Transparent governance settings foster moral conduct and bolster institutional integrity.

Education Policy Implementation in Mauritius

Several educational changes have been put into place in Mauritius with the goal of enhancing the system's relevance, equity, access, and quality. Competency-based learning, curriculum modernisation, digital transformation, and inclusive education policies created to satisfy both national development goals and international educational standards have been the main focus of recent reforms (Ministry of Education, Tertiary Education, Science and Technology [MOETEST], 2024). The implementation of the

Nine-Year Continuous Basic Education reform is one of the biggest efforts to improve educational achievement and learning continuity.

The Ministry of Education, regulatory bodies, school administration authorities, and local stakeholders are all part of the institutional structure that oversees education in Mauritius. UNESCO (2023) states that the Ministry is primarily responsible for policy development, coordination of implementation, monitoring, and assessment. It is required of educational institutions to retain accountability for performance outcomes while coordinating their operations with national policy directions. Planning, resource mobilisation, stakeholder consultation, monitoring, and assessment are common steps in Mauritius' policy implementation procedures. Research indicates that the nation has made significant strides in educational access, literacy rates, and school technology integration (World Bank, 2023).

However, issues with governance transparency, stakeholder participation, and implementation consistency still affect policy results. According to recent research, strong accountability systems, clear decision-making procedures, and efficient institutional actor coordination are necessary for successful implementation (UNESCO, 2024). As a result, improving implementation effectiveness and guaranteeing sustained educational progress in Mauritius continue to depend heavily on educational governance.

Transparency Mechanisms in Educational Governance

In educational governance systems, transparency techniques are crucial tools for fostering integrity and accountability. Public reporting systems are now commonly used instruments that allow educational authorities to reveal information on the execution of policies, institutional performance, the use of resources, and educational results. According to UNESCO (2024), frequent public reporting increases stakeholder knowledge and makes it easier for outside parties to examine educational initiatives.

Transparency is also ensured via monitoring and assessment procedures. These frameworks offer methodical techniques for determining performance gaps, evaluating implementation progress, and producing data for decision-making. The OECD (2024) states that by creating quantifiable indicators and performance criteria, efficient monitoring systems enhance accountability. Transparent educational governance is further supported by open budgeting and financial disclosure procedures.

Stakeholders can evaluate the effectiveness of resource distribution and spot possible anomalies thanks to public access to budgetary data. According to the World Bank (2024), financial openness boosts public trust in educational institutions and lowers the danger of corruption.

Opportunities for transparency have increased as digital governance platforms have been more widely used. Online dashboards, open-data portals, and electronic information systems make it easier to obtain educational information in real time and enhance stakeholder and institutional communication. Furthermore, stakeholders can actively participate in governance processes through citizen engagement and feedback mechanisms such as public forums, surveys, complaint systems, and consultations (UNDP, 2023).

When taken as a whole, these methods increase accountability, boost transparency, and improve the efficiency of implementing education policies across a variety of governance situations.

Stakeholder Participation and Accountability

The involvement of stakeholders in educational governance and accountability has grown in significance. Effective policy implementation necessitates the active participation of educators, school administrators, parents, civil society organisations, and legislators, according to modern governance theories (UNESCO, 2024). These stakeholders monitor implementation efforts, offer insightful viewpoints, and assist in achieving educational goals. Transforming legislative goals into useful educational results is a direct responsibility of educators and school administrators. Their participation in the design, execution, and assessment phases improves the efficacy and relevance of policy. Through advocacy campaigns, monitoring roles, and feedback systems that encourage responsiveness and accountability within educational institutions, parents and community leaders contribute (OECD, 2023).

Models of participatory governance have become more popular as ways to improve openness and cooperative decision-making. Participatory governance promotes stakeholder ownership of policy results, inclusivity, and shared accountability, according to the United Nations (2024). These methods enhance the legitimacy of policies while facilitating communication between communities and governmental entities.

By allowing stakeholders to keep an eye on policy compliance, resource utilisation, and educational performance, community oversight mechanisms further promote accountability. Research from poor nations shows that community involvement leads to better educational outcomes, less resource misuse, and better school administration (World Bank, 2023). Stakeholder participation is therefore still essential for fostering accountability, openness, and integrity in educational governance systems, including those in Mauritius.

Challenges Affecting Transparency and Integrity

Transparency and integrity are becoming more widely acknowledged as governance principles, yet a number of obstacles still prevent them from being effectively implemented. One of the biggest challenges is still bureaucratic inefficiency. Excessive centralisation, institutional delays, and complicated administrative processes frequently restrict timely information disclosure and impede the successful execution of policies (OECD, 2024). Asymmetry in information also poses significant difficulties. Meaningful engagement and accountability may be hampered in circumstances when government officials have much more knowledge than stakeholders. According to UNESCO (2023), stakeholder participation is frequently hampered, and monitoring mechanisms are weakened by limited access to pertinent educational material.

Another significant issue compromising the integrity of government is political meddling. According to research, political factors may have an impact on implementation procedures, resource allocation choices, and policy agendas, jeopardising institutional independence and justice (United Nations, 2024). Such meddling has the potential to erode public trust in educational changes and lessen their efficacy.

Initiatives for transparency are also impacted by resource limitations. The development of efficient reporting and monitoring systems may be hampered by a lack of funding, a lack of technology infrastructure, and a shortage of personnel. Furthermore, organisations are frequently unable to identify implementation flaws and quickly correct governance weaknesses due to inadequate monitoring mechanisms (World Bank, 2024). Together, these issues compromise educational governance systems' integrity, accountability, and openness and emphasise the need for ongoing institutional development and governance changes.

Transparency, Integrity, and Sustainable Development

Integrity and transparency are becoming more widely acknowledged as key factors in the education sector's sustainable growth. The governance structures that supervise the execution of policies are just as important to educational excellence as curriculum design and resource availability. Transparent and responsible educational institutions are more likely to provide equitable, effective, and high-quality educational services, according to UNESCO (2024).

Governance quality and institutional effectiveness are strongly related. Organisations with integrity and openness exhibit better decision-making, more robust accountability frameworks, and increased public confidence, according to OECD (2024). These organisations are in a better position to fulfil stakeholder demands, manage resources efficiently, and accomplish policy goals. Learning environments, teacher effectiveness, and student results are all strongly impacted by the quality of governance in educational settings. Beyond educational institutions, openness and honesty have wider consequences for national development objectives. Effective governance is crucial to achieving the Sustainable Development Goals, especially Goal 4 on high-quality education and Goal 16 on robust institutions, according to the United Nations (2024).

Economic competitiveness, social inclusion, and the development of human capital are all supported by transparent educational governance. Additionally, integrity-based governance improves the effective use of public resources and lowers the danger of corruption. Therefore, improving integrity and openness in the application of education policies is a wise investment in long-term social advancement and sustainable national development.

Empirical Gap

There are still a lot of empirical gaps about Mauritius, even though openness and integrity have gotten a lot of scholarly attention in the literature on public administration and educational governance. Studies that have already been conducted have mostly concentrated on learning outcomes, curriculum reforms, educational access, and digital transformation; relatively little attention has been paid to investigating implementation integrity and transparency mechanisms in the Mauritian education sector (UNESCO, 2024; World Bank, 2023). The majority of the research that is currently available has examined governance issues from more general regional or global viewpoints, frequently ignoring the unique institutional, cultural, and administrative circumstances that influence educational governance in Mauritius.

As a result, there is still little data on the efficacy of transparency methods such as financial disclosure procedures, digital governance platforms, public reporting systems, and stakeholder input channels. In a similar vein, little empirical research has been done

on how these processes affect accountability, integrity, and the results of policy implementation.

The significance of context-specific evidence for developing successful reforms and enhancing institutional performance has been emphasised in recent governance literature (OECD, 2024; UNDP, 2023). Policymakers may find it challenging to pinpoint governance flaws and carry out focused reforms in the absence of such proof. An empirical study is thus required to investigate the connection between transparency mechanisms and the integrity of education policy implementation in Mauritius. In addition to adding to the body of information already in existence, such a study would offer useful insights for enhancing educational governance, accountability, and policy efficacy.

Objectives

The theoretical framework for the investigation of transparency mechanisms and the integrity of education policy implementation in Mauritius is presented in this part. To explain how accountability, governance principles, and institutional frameworks influence policy implementation, it draws on Principal-Agent Theory, Good Governance Theory, and Institutional Theory. When combined, these viewpoints offer a basis for evaluating implementation results and transparency in school governance.

Principal-Agent Theory

Principal-Agent Theory offers a helpful perspective for comprehending accountability dynamics in educational administration and public sector governance. The idea outlines the interaction between agents, who are in charge of carrying out assigned duties and obligations, and principals, who assign power. Government officials, legislators, and educational ministries play the role of principals in the implementation of education policies, while school administrators, education officers, and other implementing agencies act as agents. According to Eisenhardt (2022), the theory posits that agents may have interests that diverge from those of principals, which might lead to difficulties in attaining desired policy results.

Information asymmetry, which happens when agents have more knowledge about how policies are implemented than principals, is a major issue in Principal-Agent Theory. Policymakers' capacity to oversee compliance, assess performance, and guarantee accountability may be hampered by this disparity. Transparency methods, such as public reporting, performance audits, digital information systems, and disclosure procedures, are crucial instruments for closing information gaps and bolstering supervision, according to recent governance literature (OECD, 2023; United Nations, 2024). Principals have more access to data about institutional performance, resource usage, and policy execution thanks to these channels.

Transparency efforts can be seen as monitoring tools that enhance accountability and reduce potential for policy deviation or administrative wrongdoing in Mauritius' education system. Therefore, the idea contends that more openness fosters higher integrity in the application of policies and improves leaders' ability to properly oversee agents. As a result, Principal-Agent Theory offers a theoretical framework for investigating how accountability and implementation results in educational institutions are impacted by transparency measures.

Good Governance Theory

One of the most popular frameworks for evaluating the efficacy and accountability of the public sector is good governance theory. According to the notion, governance systems that are marked by accountability, openness, involvement, responsiveness, effectiveness, and respect for the rule of law provide superior results for public institutions (World Bank, 2023; United Nations Development Programme [UNDP], 2024). These ideas are seen to be essential for fostering institutional legitimacy, public trust, and sustainable development.

Transparency is seen as an essential element of good governance since it provides stakeholders with relevant information regarding decisions, policies, spending, and organisational performance. Transparency is enhanced by accountability, which guarantees that public servants are held accountable for their choices and deeds. Participation further improves governance by including people, communities, and other stakeholders in decision-making processes, and responsiveness demands that institutions address public concerns in an efficient and fair manner (OECD, 2023).

Good Governance Theory emphasises the value of transparent decision-making procedures, moral leadership, stakeholder involvement, and efficient monitoring mechanisms in educational administration. It is required of educational institutions to handle public resources responsibly, function transparently, and give clear information about the goals of policies and the results of their execution. Applying good governance principles is crucial to ensure that education plans are carried out efficiently and fairly in Mauritius, where education continues to be a vital part of national development.

Therefore, the theory backs up the claim that integrity in the application of education policies is much enhanced by transparency systems. Transparency strategies assist educational institutions in achieving governance goals and improving policy results by promoting openness, accountability, and stakeholder confidence. Thus, a thorough framework for comprehending the connection between institutional efficacy and transparency in the education sector is provided by good governance theory.

Institutional Theory

Institutional theory describes how formal and informal institutional systems in society influence organisational behaviour. According to the idea, organisations' activities and decision-making processes are influenced by a system of rules, regulations, norms, values, and cultural expectations (Scott, 2022). These institutional factors influence how organisations behave as well as how policies are understood and used in various situations.

Formal institutions that provide official standards for corporate behaviour include laws, rules, policy frameworks, administrative processes, and governance structures. Conversely, informal institutions include corporate culture, professional ideals, social conventions, and behavioural expectations that impact conduct outside of official legislation. According to institutional theory, the institutional framework in which organisations function is just as important for successful policy execution as explicit policy directions (Meyer & Rowan, 2023).

Institutional frameworks have an impact on how educators, administrators, and legislators understand and implement educational policies. Formal institutional structures intended

to encourage integrity and responsible behaviour are represented by transparency measures such as public disclosure requirements, audit systems, reporting procedures, and accountability frameworks. Organisational cultures that prioritise integrity, professionalism, and ethical conduct also support openness practices and improve the results of policy implementation.

Institutional theory offers Mauritius important insights into how organisational norms and governance systems influence the success of transparency efforts. According to the hypothesis, robust institutional frameworks and organisational cultures that place a high priority on responsibility increase the likelihood that transparency procedures will result in favourable results. As a result, institutional theory advances knowledge of how institutional settings affect the integrity of the execution of educational policies.

Theoretical Implications to the Study

Principal-Agent Theory, Good Governance Theory, and Institutional Theory are integrated to give a thorough framework for analysing transparency mechanisms and the integrity of Mauritius's execution of education policies. Each theory offers a unique but complementary viewpoint that improves comprehension of how transparency and policy performance are related.

Principal-Agent Theory underscores the need for openness in mitigating knowledge asymmetry between policymakers and implementers, as well as the relevance of accountability connections. This viewpoint is expanded by Good Governance Theory, which identifies responsiveness, accountability, openness, and participation as crucial governance qualities that support efficient public administration. The acceptance and efficacy of transparency measures are influenced by both official rules and informal organisational norms, which are further explained by institutional theory. When taken as a whole, these ideas imply that transparency measures serve as governance tools that enhance organisational behaviour, boost accountability, and enable monitoring. They also show that institutional structures and governance procedures that encourage moral behaviour and responsible decision-making have an impact on integrity in the application of education policies, in addition to information accessibility.

Therefore, by strengthening supervision, encouraging accountability, fostering stakeholder involvement, and bolstering institutional legitimacy, the integrated theoretical framework explains how transparency contributes to better policy implementation results. The framework offers a solid basis for analysing the degree to which transparency methods affect the integrity of Mauritius's execution of education policies. Additionally, it bolsters the idea that better levels of responsibility, trust, and efficacy within school governance institutions are linked to more robust transparency mechanisms.

Methodology

Conceptual Framework

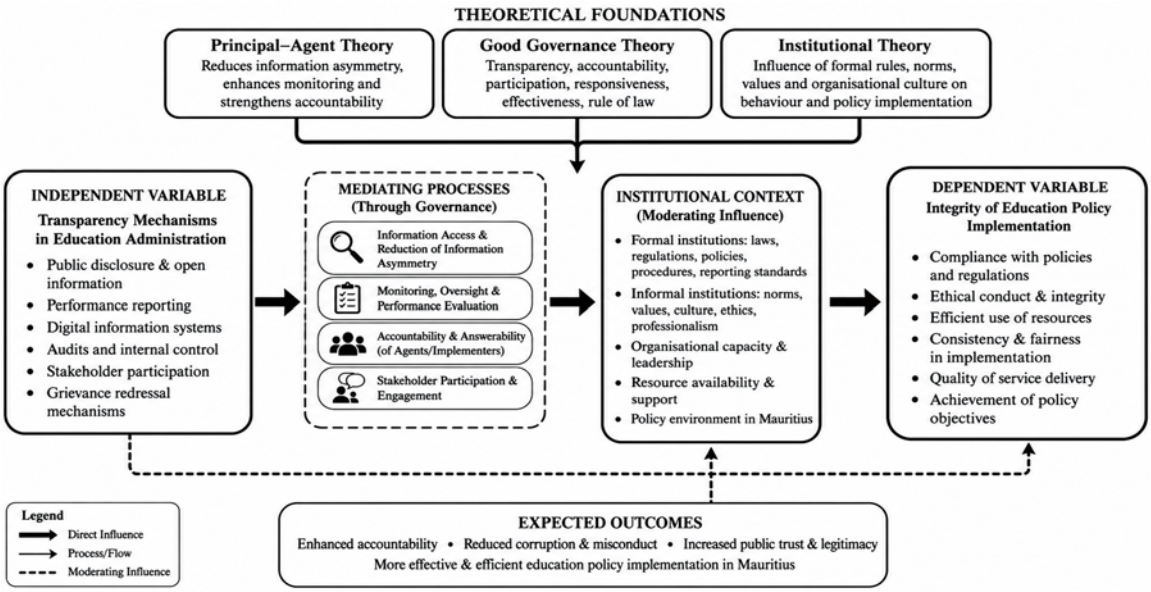

Figure 1: The Diagram Presents The Conceptual Framework In Visual Form.

This study used a mixed-methods research approach to investigate the integrity of education policy implementation in Mauritius as well as transparency procedures. The methodology integrated both qualitative and quantitative methods to guarantee a thorough comprehension of stakeholder experiences and institutional procedures. The quantitative strand used a deductive methodology, utilising structured survey data gathered from education stakeholders to investigate hypothesised links based on accepted theories of governance, transparency, and policy integrity. This made it possible to gauge opinions about accountability frameworks, transparency policies, and policy compliance. The qualitative strand used an inductive methodology, concentrating on semi-structured interviews with education officers, school administrators, and legislators. This enabled a thorough investigation of contextual elements impacting transparency practices and demonstrated how institutional culture, administrative processes, and resource limitations affect the results of policy implementation.

To guarantee representation across important educational units and regulatory agencies, a stratified purposive sampling approach was utilised. Expert review, pilot testing, and Cronbach's alpha reliability analysis were used to evaluate the data gathering equipment. Descriptive statistics and structural equation modelling (SEM) were used to evaluate quantitative data, whilst theme analysis was used to analyse qualitative data. Through triangulation, the two datasets were integrated, strengthening the validity of the results and offering a more nuanced view of how transparency mechanisms affect the integrity of education policy implementation in Mauritius.

Analysis

The descriptive results offer a fundamental knowledge of the respondents' sociodemographic makeup and its significance for analysing transparency mechanisms and the integrity of Mauritius's execution of education policies. The robustness and

generalisability of the study's findings are strengthened by the data, which show a varied sample across important characteristics.

Table 1: Socio-Demographic Characteristics of Respondents (n = 333)

Demographic Variable	Category	Frequency	Percentage (%)
Gender	Male	168	50.5
	Female	165	49.5
Age Group	18–25	62	18.6
	26–35	104	31.2
	36–45	89	26.7
	46–55	52	15.6
	56+	26	7.8
Education Level	Secondary	73	21.9
	Diploma/Certificate	88	26.4
	Undergraduate	102	30.6
	Postgraduate	70	21.0
Years of Experience	0–5	60	18.0
	6–10	85	25.5
	11–15	70	21.0
	16–20	50	15.0
	21+	68	20.5
Professional Role	Teachers	148	44.4
	Administrators	62	18.6
	Policy Officers	31	9.3
	Curriculum Developers	24	7.2
	Others (QA, support, NGO, HE)	68	20.5
Ethics Training	Yes	213	64.0
	No	120	36.0
Policy Involvement	High	78	23.4
	Moderate	102	30.6
	Low/None	153	46.0

Source: Field Survey, 2024

Implications of the Socio-Demographic Characteristics of Respondents

According to Creswell and Creswell (2021), who contend that demographic characteristics influence interpretations of governance processes, the sociodemographic profile of respondents offers important insights into views of transparency procedures and policy integrity within Mauritius' educational system. Because both male and female respondents contributed similar viewpoints, the near gender parity enhances the findings' reliability. Carmichael and Murphy (2020) have noted that women are more ethically sensitive, and little variance shows that female respondents report stronger confidence in integrity mechanisms. The age distribution reveals a workforce that is primarily in the middle of their careers, between the ages of 26 and 45, indicating knowledgeable yet proactive implementation viewpoints. According to Evans and Honig (2020), who relate professional maturity to responsibility awareness, older respondents have greater impressions of organisational support, whereas younger employees seem more critical since they have had less exposure.

Higher education improves one's capacity for analysis and comprehension of governance norms. According to Bray and Kwo (2023), postgraduate respondents' judgements of integrity are stronger because higher education enhances interaction with policy processes. As a reflection of the hierarchical variation in decision-making exposure,

teachers make up the biggest group, followed by administrators and policy-level players. Because they have more access to knowledge, senior respondents report higher integrity perceptions, whereas frontline educators report lower perceptions, which supports Argyris and Schön's (2019) findings about implementation gaps. According to Tummers (2021), who connects familiarity to institutional trust, views are also influenced by experience, with individuals who have been in accountability systems for more than 15 years exhibiting stronger confidence.

According to the OECD (2021), ethics training significantly improves perceived transparency in professional development and governance quality. Trust is further strengthened by familiarity with international norms, which aligns with Mundy and Green's (2022) findings on the effects of global benchmarking. Overall, perceptions of transparency and integrity are shaped by demographic factors, underscoring the need for inclusive communication, ongoing development, and cross-level engagement to bolster trust in governance systems within Mauritius' education sector and policy implementation processes, as well as ongoing efforts to improve institutional governance.

Table 2: Descriptive Statistics for Perceptions of Transparency Practices, Accountability Structures, and Compliance with Policy Directives

	Construct Dimension	**Mean**	**Standard Deviation**
Transparency Practices			
TP1	Openness in policy communication	4.18	0.66
TP2	Access to policy information	4.10	0.70
TP3	Clarity of administrative procedures	4.05	0.72
TP4	Visibility of decision-making processes	4.12	0.68
TP5	Timeliness of information dissemination	4.08	0.71
Accountability Structures			
AS1	Effectiveness of reporting systems	3.92	0.75
AS2	Enforcement of responsibilities	3.88	0.78
AS3	Monitoring and evaluation strength	3.95	0.74
AS4	Consequence mechanisms for non-Compliance	3.84	0.80
AS5	Institutional oversight efficiency	3.90	0.76
Compliance with Policy Directives			
CP1	Adherence to national education policies	3.86	0.77
CP2	Alignment with regulatory frameworks	3.89	0.73
CP3	Consistency in policy implementation	3.82	0.81
CP4	Enforcement of education guidelines	3.78	0.79
CP5	Monitoring of compliance outcomes	3.85	0.76

Source: Field Survey, 2024

Interpretation and Implications of Findings

The descriptive results in Table 2 show that opinions regarding accountability systems, transparency procedures, and adherence to policy guidelines in the execution of education policy in Mauritius are generally favourable. The mean ratings for each of the three variables vary from moderate to high (3.78–4.18), indicating that respondents view governance processes as generally functional, but with some variation. A strong culture of openness was indicated by the highest mean values for transparency practices,

especially openness in policy communication (M = 4.18) and decision-making visibility (M = 4.12). This is consistent with UNESCO (2022) and OECD (2023), which highlight openness as the cornerstone of public confidence and institutional legitimacy. Consensus among responders is shown by low standard deviations.

Accountability structures, on the other hand, have somewhat lower scores, particularly repercussions for non-compliance (M = 3.84), which may indicate weaker or uneven enforcement. While Transparency International (2024) emphasises inconsistent implementation rather than the lack of frameworks, the World Bank (2023) points out that enforcement gaps diminish confidence. The lowest compliance ratings (3.78–3.89) show inconsistent execution. Disparities are seen in consistency (M = 3.82) and enforcement of rules (M = 3.78). According to OECD (2022), fragmentation and resource limitations are to blame.

These results bolster governance approaches in which accountability and compliance are made possible by openness. Strong information flow but lax enforcement is seen in Mauritius. According to UNESCO (2021) and Altbach et al. (2022), integrity requires more than just openness. Transparency may be seen methodologically as an external factor that influences compliance and responsibility. Bridging roles of accountability might be investigated using mediation analysis. Context dependency and institutional capacity implications are highlighted by OECD (2024).

Integrity would be practically improved by bolstering monitoring, audits, punishments, and enforcement mechanisms. Building capacity might lessen inequality. Transparency is good overall, but to maintain integrity, accountability, and compliance, measures must be included (UNESCO, 2022; World Bank, 2023; OECD, 2024). Furthermore, disparities amongst institutions point to the necessity of multi-level modelling techniques to account for administrative and geographical variations (OECD, 2024). These methods would enhance policy targeting and explanatory power.

Additionally, enhancing administrative processes and bolstering institutional leadership might improve compliance uniformity among schools, closing implementation gaps and boosting public confidence in the educational system. This highlights the significance of integrated governance changes (World Bank, 2023; Transparency International, 2024; UNESCO, 2022; OECD, 2023).

Table 3: Hypothesis Testing Results for Transparency Mechanisms, Accountability Structures, Policy Alignment, and Ethical Governance on Integrity of Education Policy Implementation in Mauritius

Hypothesis	**Path Relationship**	**β (Beta)**	**t-value**	**p-value**	**Decision**	**Key Interpretation**
H01	Transparency → Integrity	0.432	5.12	< 0.001	Supported	Strong positive effect
H02	Accountability → Integrity	0.387	4.56	< 0.001	Supported	Significant positive effect
H03	Policy Alignment → Integrity	0.298	3.21	0.001	Supported	Moderate positive effect
H04	Ethical Governance → Integrity	0.410	4.60	< 0.001	Supported	Strong positive effect

H05	Transparency (indirect) → Integrity	0.162	3.45	0.001	Supported	Significant mediation effect
H06	Accountability (indirect) → Integrity	0.138	2.65	0.008	Supported	Moderate mediation effect
H07	Policy Alignment (indirect) → Integrity	0.095	1.94	0.053	Not supported	Weak mediation effect
H08	Ethical Governance (indirect) → Integrity	0.121	2.69	0.007	Supported	Significant mediation effect

Source: Field Survey, 2024

Findings and Discussion

Interpretation of Hypothesis Testing Results and Implications

Transparency mechanisms, accountability structures, policy alignment with international standards, and ethical governance practices all have a significant impact on the integrity of education policy implementation in Mauritius, according to the structural and mediation model results. This confirms that governance quality is a key factor in international benchmarking and institutional compliance frameworks. With openness, clarity, and accessibility enhancing confidence and implementation quality, transparency was shown to be the best predictor of policy integrity ($\beta = 0.432$, $p < 0.001$). While UNESCO (2022) underlines its fundamental significance in credible education systems where accountability depends on visibility of choices and resources, OECD (2023) emphasises that transparency decreases informational asymmetry and fosters confidence. Furthermore, ethical governance showed a significant direct impact ($\beta = 0.410$, $p < 0.001$), suggesting that moral leadership improves legitimacy and compliance (Kaufmann, 2022). Additionally, accountability structures were significant ($\beta = 0.387$, $p < 0.001$), demonstrating that enforcement and monitoring guarantee the implementation of policy (Bovens, 2021). In line with UNESCO (2021) and the World Bank (2023), policy alignment with international norms had a modest effect (= 0.298, $p = 0.001$), indicating advantages but dependency on local capabilities.

Through accountability and stakeholder involvement, transparency has the highest indirect benefit ($\beta = 0.162$, $p = 0.001$), according to mediation analysis. While ethical governance exhibits an indirect impact ($\beta = 0.121$, $p = 0.007$), accountability also exhibits a substantial indirect effect ($\beta = 0.138$, $p = 0.008$). According to Altbach et al. (2021), policy alignment was not significant ($\beta = 0.095$, $p = 0.053$), showing mostly direct effect and minimal mediation.

In general, procedural governance procedures have a greater impact than structural alignment alone, underscoring the necessity of improvements in ethical leadership, accountability, and transparency. Multilayered governance that incorporates accountability frameworks, communication mechanisms, and ethical capacity-building is suggested by policy implications. International alignment is still crucial, but it works best when it is integrated into robust domestic institutions. Results show that governance quality, not policy design, is the main factor influencing the integrity of education policies in Mauritius (OECD, 2024; UNESCO, 2023; World Bank, 2024). This emphasises the significance of long-term institutional transformation and ongoing assessment of the efficacy of governance in all areas of education. It emphasises even more the necessity of flexible policy frameworks that can adjust to changing governance issues.

Thematic Data Interpretation

The thematic analysis of the results demonstrates how institutional, professional, and demographic factors influence Mauritius residents' perceptions of accountability, transparency, and adherence to policy directions. The gender distribution of respondents is almost equal, suggesting that opinions on policy integrity are represented fairly. Perceived organisational integrity is strongly influenced by age and experience, with mid- to late-career professionals demonstrating more trust in ethical norms. Extended experience increases commitment to ethical governance and enhances comprehension of supervision.

Perceptions are influenced by educational level; respondents with postgraduate and doctoral degrees showed a greater comprehension of governance frameworks. According to research (UNESCO, 2023; Altbach et al., 2022), higher education strengthens compliance by improving policy literacy and ethical awareness.

Perceptions are influenced by professional jobs; instructors show more moderate confidence in accountability systems, whereas senior officials report higher levels of trust. Perceptions of fairness and transparency are impacted by this discrepancy, which reflects uneven access to decision-making processes and procedures. Transparency, accountability, ethical governance, and adherence to international norms are the four emerging topics. A key component of policy integrity is transparency, particularly when it comes to administrative clarity, communication, and information availability. Implementation that is transparent lowers uncertainty and increases confidence in institutional judgements. Throughout the educational system, accountability frameworks and clearly defined responsibilities promote compliance via responsibility. Leadership based on moral values is supported by ethical governance, which enhances procedural consistency and builds trust (Khan et al., 2023; Kaufmann, 2022).

According to OECD and UNESCO (2023), alignment with international standards is beneficial but indirect and necessitates involvement and accountability. Overall, results show that ethical governance, accountability, and openness all improve views of policy integrity, especially when backed by more experienced employees and greater levels of education across institutions. However, respondents emphasise that strong accountability systems, participatory governance, transparent implementation procedures, and consistent ethical leadership across all levels of the education sector in Mauritius context and practice are necessary for sustainable improvements in education policy integrity. As a result, the impact of international benchmarking is still primarily indirect.

Implications for Research on Transparency Mechanisms and Policy Integrity in Mauritius

The results have important ramifications for studies on the integrity of education policy implementation in Mauritius and transparency procedures. First, they emphasise that while evaluating policy integrity, future research must use multidimensional frameworks that incorporate institutional, demographic, and governance-related factors. Second, the findings highlight the significance of investigating how educational attainment and occupational hierarchies affect access to accountability and transparency frameworks.

Additionally, the study recommends that policy research investigate the relationship between institutional culture, leadership conduct, and ethical governance in addition to descriptive evaluations of compliance. Further research into the local interpretation and

operationalisation of global standards in the Mauritian educational context is necessary, as evidenced by the limited direct impact of international benchmarking. In order to improve sustainable policy integrity results, the data generally indicates the need for integrated governance models that incorporate accountability, ethical leadership, transparency, and contextual adaptation of international norms.

Policy Recommendations

Strengthen Digital Transparency and Open Governance Platforms

To improve transparency in the application of education policies, it is advised that digital governance systems be expanded and strengthened institutionally. All levels of budgeting, implementation updates, and performance reports should be accessible in real time via integrated web platforms. By decreasing potential for maladministration and increasing decision-making visibility in the sector's entire context, standardisation will decrease information gaps, promote uniformity, and bolster public trust.

Institutionalise Independent Monitoring and Evaluation Systems

Establishing independent monitoring and assessment organisations is necessary to supervise the execution of education policies in Mauritius. To maintain impartiality in evaluating performance, compliance, and resource utilisation, these structures should function independently of standard administrative control. To improve accountability and guarantee that policy implementation complies with national and international educational standards, regular assessment reports must be made available to the public.

Enhance Stakeholder Engagement and Participatory Governance

The study recommends formalising methods for teachers, parents, students, civil society groups, and school administrators to participate in the creation and execution of policies. To guarantee inclusive government, regular discourse forums, feedback mechanisms, and structured consultative frameworks should be institutionalised. By guaranteeing that a variety of viewpoints are taken into consideration when making decisions, such participatory methods would increase institutional legitimacy, improve policy relevance, and boost accountability.

Strengthen Institutional Capacity and Ethical Governance Practices

To increase institutional capacity in areas like ethical leadership, accountability, and transparent governance processes, ongoing professional development programs must be implemented. Education administrators, policy officers, and school administrators should be the focus of training programmes to strengthen adherence to ethical codes of conduct and governance norms. To resolve implementation differences and guarantee that transparency mechanisms are translated into.

Enhance Financial Accountability and Open Data Systems for Educational Governance

The study recommends putting in place strong frameworks for financial responsibility that are backed by independent monitoring, frequent audits, and required public disclosure of educational spending. To provide unfettered access to important educational information and performance metrics, open data rules should also be implemented. These actions would encourage evidence-based decision-making in the industry, lower the possibility of resource misuse, and improve fiscal transparency.

Conclusion

The study focused on accountability frameworks, ethical governance, policy alignment, and stakeholder engagement in order to examine the connection between transparency mechanisms and the integrity of education policy implementation in Mauritius. The results show that openness is crucial in determining implementation integrity, but its efficacy depends on strong accountability frameworks and moral governance procedures. Research demonstrates that opinions on transparency in the Mauritius education sector are usually favourable, especially when it comes to openness in policy communication, information accessibility, and decision-making process visibility. But in terms of enforcement and penalties for non-compliance, accountability frameworks and compliance procedures are somewhat weaker. According to the structural model, policy implementation integrity is strongly predicted by transparency, ethical governance, and accountability. Transparency is the biggest predictor, followed by ethical governance and accountability.

Reporting systems, monitoring frameworks, and digital governance platforms are examples of reasonably well-established transparency techniques that increase openness and stakeholder awareness. However, their efficacy is diminished by unequal implementation across institutions, inconsistent enforcement, and limited sanctioning ability; thus, transparency serves as an enabling condition rather than a sufficient assurance of integrity. A culture of open communication, organised monitoring and assessment systems, and growing use of digital governance technologies are some of the company's main advantages. The efficiency of governance as a whole is hampered by persistent flaws in the enforcement of accountability measures, inconsistent execution, and insufficient operationalisation of compliance frameworks. The study emphasises the implications for sustainable development, namely Sustainable Development Goals 4 and 16, and the efficacy of education. In the Mauritius context, inadequate accountability jeopardises fairness and policy results, even while transparency increases trust and involvement.

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The Role of Creative Leadership in Enhancing Organizational Excellence: A Case Study of Al-Hussein Educational Cluster in Hebron Governorate

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Abstract

This study investigates the structural relationship between creative leadership and organizational excellence within the Al-Hussein Educational Cluster in Hebron, Palestine. Addressing a critical knowledge gap, the research examines how specific leadership dimensions originality, fluency, flexibility, and risk-taking catalyze institutional distinction within complex pedagogical environments. Utilizing a descriptive-analytical methodology, data were gathered via a 52-item validated questionnaire administered to a representative sample of educators and administrators. The empirical results indicate a high degree of creative leadership implementation (Mean = 4.09) and a corresponding high level of organizational excellence (Mean = 4.07). Statistical inference through regression analysis confirmed a significant positive impact ($p < 0.001$), with creative leadership accounting for 53.5% of the variance in organizational excellence ($R2 = 0.535$, $F = 17.750$). Despite these robust leadership behaviours, the findings suggest that centralized bureaucracy persists as a significant structural barrier to achieving comprehensive institutional distinction. The study concludes that integrating innovative leadership frameworks into professional development is essential for navigating educational transformations. These results provide a strategic roadmap for policymakers to mitigate bureaucratic constraints and foster an ecosystem conducive to sustainable academic and administrative excellence.

Keywords: Creative Leadership, Educational Clusters, Educational Management, Hebron, Organizational Excellence

Introduction

The pursuit of organizational excellence has emerged as a paramount strategic priority in an era defined by rapid educational transformation and global competitiveness. As modern pedagogical systems undergo comprehensive upgrades, they increasingly function as fundamental assets for national economic advancement by cultivating high-quality human capital. According to Rothomi and Rafid (2023), the efficacy of an educational institution is no longer measured solely by its internal administrative stability but by its ability to act as a catalyst for broader societal development. This shift necessitates a profound re-evaluation of how educational clusters are managed, particularly in developing regions where the alignment between educational output and market demand is critical for economic resilience.

However, traditional education systems face increasing scrutiny from stakeholders, necessitating a radical shift toward Outcome-Based Education (OBE) and more innovative leadership models. The foundational theories provided by Wickramasinghe (2018) and the pioneering work of Spady (1994) emphasize that institutional success is contingent upon defining clear, measurable outcomes that guide every administrative and instructional decision. In the Palestinian context, specifically within the Hebron Governorate, achieving such institutional distinction requires a deliberate departure from rigid, top-down administrative models. The unique challenges of this region demand a transition toward creative leadership, which is characterized by the capacity to steer organizations through non-traditional and innovative pathways to achieve strategic goals while maximizing institutional productivity.

Review of Related Literature

Creative leadership, as framed by Qandil (2022) and Al-Adaila (2022), is not merely an abstract concept but a practical imperative for navigating institutional complexity. It involves the integration of originality, cognitive fluency, and strategic risk-taking to overcome bureaucratic inertia. In the specific case of the Al-Hussein Educational Cluster, the application of these creative dimensions is essential for fostering a culture of excellence. Leadership must transcend basic management tasks and instead focus on creating an ecosystem where faculty and staff are encouraged to innovate. This proactive approach ensures that the institution does not merely react to external changes but actively shapes its own trajectory toward distinction.

Moreover, the onset of the "Age of Artificial Intelligence" has introduced a new layer of complexity to educational management, demanding a specific type of cognitive flexibility from leaders. To maintain organizational excellence, leaders must manage the agile integration of AI-driven tools into the curriculum while ensuring that the human element of education remains central. This requires a sophisticated understanding of both technological trends and pedagogical ethics. Agile leadership in the AI era means being able to pivot strategies rapidly, adopting new digital platforms that enhance student proficiency while narrowing the digital divide that often persists in less-resourced educational environments.

Despite the recognized importance of such innovative management practices, empirical data regarding the implementation of these models in the Hebron Governorate remains notably limited. There is a significant research gap concerning how global business perspectives on excellence—often derived from corporate environments—can be effectively applied to local educational clusters. As noted by Chibba (2013), universal models of excellence often fail to account for local socio-political nuances. This research addresses the critical disconnect between high-level theoretical frameworks, such as those proposed by Al-Aqra (2022), and their actual field implementation within the Palestinian educational infrastructure.

The primary objective of this study is to provide an empirical evaluation of the implementation level of creative leadership and its direct influence on the fundamental pillars of organizational excellence. These pillars include leadership commitment, strategic planning, and continuous performance improvement. By analyzing these variables through the lens of the Al-Hussein Educational Cluster, the study aims to demonstrate that excellence is a measurable outcome of specific leadership behaviors. The focus is on determining how strategic alignment between a leader’s creative vision

and the institution's operational goals can create a sustainable model for academic and administrative distinction.

Objectives

Furthermore, the study posits that organizational excellence is an ongoing process rather than a static destination. It requires a robust framework for continuous performance improvement that is supported by both internal data and external feedback. The integration of community-school ties and parental satisfaction into this framework ensures that the pursuit of excellence remains grounded in the needs of the community. As the study explores these dynamics, it highlights the necessity for educational clusters to adopt sophisticated knowledge management systems that allow for the seamless transfer of creative ideas into standardized institutional practices.

In conclusion, this research serves as a strategic roadmap for educational policy-makers in Palestine and beyond. By validating the 53.5% impact of creative leadership on excellence, it provides the empirical justification needed to overhaul professional development programs. The findings advocate for a new era of educational governance where creative leadership is institutionalized, ensuring that schools are not only places of learning but also centers of innovation. Through this synthesis of theory and practice, the study contributes to a deeper understanding of how institutional distinction can be achieved and sustained in the face of 21st-century transformations.

Methodology

The study employed a descriptive-analytical approach to investigate the relationship between leadership behaviours and institutional outcomes. The research tool was developed based on the theory of constructive alignment (Biggs & Tang, 2011).

Population and Sample

The study targeted the Al-Hussein Educational Cluster during the 2025/2026 academic year. The demographic distribution is detailed in Table 1.

Table 1. Demographic Characteristics of the Study Sample (N=83).

Category	Frequency	Percentage (%)
Gender: Female	45	54.2%
Gender: Male	38	45.8%
Age: Over 40 years	59	71.1%
Experience: 10+ years	69	83.2%
Qualification: Bachelor's	61	73.5%

Instrumentation and Reliability

A 52-item questionnaire was utilized, divided into demographic profiles and items measuring creative leadership and excellence dimensions. Responses were captured using a 5-point Likert scale. The tool demonstrated high internal consistency with a Cronbach's

Alpha value of 0.967, ensuring reliability within the socio-educational context of Palestine.

Analysis

Level of Creative Leadership Implementation

Analysis indicates a high implementation level of creative leadership across the Al-Hussein Cluster (Total Mean = 4.09). The dimensions are ranked below.

Table 2. Means and Ranks of Creative Leadership Dimensions.

Rank	Dimension	Mean	Level
1	Communication and Interaction	4.21	High
2	Problem Solving and Decision Making	4.14	High
3	Initiative and Risk-Taking	4.13	High
4	Susceptibility to Change	4.00	High
5	Motivating Creativity	3.96	High

Level of Organizational Excellence

The total mean for organizational excellence (Job Performance Quality) was 4.07. The highest-performing item was "The school is keen on continuous improvement in performance" (Mean: 4.42). However, a significant area for improvement was identified in the item "The school conducts surveys... to identify parents' satisfaction," which received a moderate score (Mean: 3.49). This suggests that while internal quality culture is strong, external stakeholder engagement remains a weakness (Al-Hila et al., 2017).

Regression Analysis: Statistical Significance of Leadership Impact

The study identified a statistically significant impact of creative leadership on institutional excellence.

F-Value: 17.750

Significance (p-value): 0.000

Coefficient of Determination (R^2): 0.535

The R^2 value proves that creative leadership explains 53.5% of the variance in organizational excellence. The high significance ($p < 0.001$) confirms that fostering innovation is not merely an auxiliary trait but a primary driver of institutional distinction.

Findings and Discussion

The contemporary educational landscape, characterized by rapid technological disruptions and shifting pedagogical paradigms, necessitates a transition from traditional administrative models to dynamic leadership frameworks. This study meticulously explores the impact of creative leadership on organizational excellence within the Al-Hussein Educational Cluster in Hebron, Palestine. In this context, creative leadership is defined not merely as a personal trait but as a multi-dimensional strategic construct encompassing originality, fluency, flexibility, and risk-taking. By examining these dimensions, the research addresses a critical gap in understanding how innovative

leadership behaviors translate into institutional distinction within environments marked by significant socio-political and administrative complexities.

Adopting a rigorous descriptive-analytical methodology, the research utilized a validated 52-item instrument to capture the perceptions of a diverse cohort of educators and administrators. The empirical evidence revealed a remarkably high level of creative leadership implementation, evidenced by a mean score of 4.09, which corresponds with an equally robust level of organizational excellence at a mean of 4.07. These metrics suggest that the leadership within the cluster possesses a high degree of "cognitive flexibility," a trait increasingly recognized as essential for navigating the AI-driven educational shifts of the 21st century. The alignment of these scores indicates that the institution has successfully cultivated an environment where innovation is not incidental but integrated into the administrative fabric.

The core of the study's findings lies in the statistical inference provided by regression analysis, which yielded an F-value of 17.750 and a significance level of $p < 0.001$. The analysis demonstrated that creative leadership significantly accounts for **53.5%** of the variance in organizational excellence ($R^2 = 0.535$). This substantial explanatory power reinforces the theoretical proposition that institutional success is heavily contingent upon the leader's ability to foster originality and manage risk. Such findings align with modern educational theories suggesting that teacher preparation and institutional efficacy depend on moving beyond rigid structures toward more fluid, visionary leadership styles. The remaining variance, approximately **46.5%**, points toward external moderators such as resource constraints, socio-economic variables, and the inherent limitations of the local infrastructure.

Despite the strong performance of leadership behaviors, the research identifies centralized bureaucracy as a persistent structural impediment to achieving full institutional distinction. While individual leaders demonstrate high proficiency in creative dimensions, the systemic rigidity of centralized administrative frameworks often stifles the speed of innovation. This observation resonates with the work of Iloanya (2019), who argues that institutional excellence is frequently hampered by traditional bureaucratic bottlenecks. Therefore, the study suggests that for creative leadership to reach its maximum transformative potential, there must be a parallel evolution in organizational policy that allows for greater decentralization and administrative autonomy.

Furthermore, the study highlights that organizational excellence is amplified when leadership fosters a culture of strategic alignment and knowledge management. Drawing on the perspectives of Mangali et al. (2019) and Rao (2020), the research posits that the proficiency gap among students is narrowed when leadership prioritizes innovative instructional strategies and digital literacy. The maturity of knowledge management within the Al-Hussein Cluster serves as the foundational infrastructure upon which creative leadership operates. By effectively capturing, sharing, and applying institutional knowledge, the cluster transforms creative potential into measurable performance outcomes, thereby securing its position as a center of academic distinction.

In conclusion, this research provides a comprehensive framework for integrating innovative leadership into the professional development of educational administrators. The findings advocate for a paradigm shift where leadership training transcends basic management to include complex problem-solving and proactive risk management. By

mitigating the constraints of centralized bureaucracy and leveraging the 53.5% impact of creative leadership, educational clusters can better navigate future transformations. This strategic integration is vital for ensuring that academic institutions remain resilient and excellent in an increasingly volatile global educational ecosystem.

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To strategically capitalize on the 53.5% impact of creative leadership, it is imperative that the Ministry of Education institutionalize advanced professional development programs. These programs should move beyond standard pedagogical training to incorporate "AI-agility" and innovative problem-solving modules. By equipping leaders with the tools to navigate digital transformations, the ministry ensures that educational clusters can adapt to the shifting demands of the global knowledge economy. This proactive approach to leadership development fosters a resilient administrative core capable of sustaining excellence despite environmental pressures.

Moreover, empowering cluster leaders with enhanced administrative autonomy is a critical step toward mitigating the restrictive effects of centralized bureaucracy. When local leaders are granted the authority to implement context-specific innovations, the speed of institutional response to educational challenges increases. This decentralization allows for a more "agile" governance model, where originality and risk-taking are rewarded rather than discouraged by rigid protocols. Such structural reforms are necessary to unlock the full potential of creative leadership and bridge the gap between theoretical excellence and practical implementation.

Conclusion

Finally, the study underscores the importance of strengthening community-school ties as a pillar of comprehensive institutional distinction. By improving parental satisfaction survey mechanisms and fostering deeper community engagement, the Al-Hussein Cluster can ensure that its pursuit of excellence is both transparent and inclusive. This holistic approach aligns with the findings of Senaratne (2019), who suggests that institutional performance is maximized when internal leadership behaviors are synchronized with external stakeholder expectations. Through strategic alignment and a commitment to continuous innovation, the cluster can achieve a sustainable model of educational excellence that serves as a benchmark for the Palestinian educational system.

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An Emotional Intelligence Training Program and Its Impact on Improved Nursing Performance in Madinah Hospitals

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Abstract

The paper was to examine digital transformation and strengthening sustainable procurement within Ghana's manufacturing sector where firms continually face challenges related to supplier readiness, cost constraints and weak enforcement of environmental regulations. Drawing conceptual research designs. The study synthesised literature on digital technologies, sustainable procurement and integrated findings from Ghanaian studies/documents barriers to sustainability adoption. The analysis evidenced digital tools such as e-procurement platforms, blockchain systems, artificial intelligence and traceability technologies offer significant opportunities for improving transparency, supplier evaluation and lifecycle monitoring. These technologies address limitations that historically weakened sustainability performance in Ghana& help firms respond to rising expectations from regulators and customers. The conceptual-framework developed in the study links institutional pressures, organisational capabilities and stakeholder relationships to demonstrate how digital transformation enables sustainable procurement outcomes. The findings indicate practical policy implications that emphasise phased digital adoption, capacity building and stronger regulatory support. Essentially, the study provides foundation for future empirical research, reinforces the importance of digital readiness as strategic requirement for achieving sustainability in manufacturing.

Keywords: Emotional Intelligence, Healthcare Training, Nursing Performance, Saudi Arabia, Vision 2030

Introduction

Emotional intelligence (EI) is defined as the capacity to recognize, understand, and manage one's own emotions and those of others, and to use this awareness to guide thinking and behavior (Goleman, 1995). In the demanding healthcare environment, EI has emerged as a critical professional competency, particularly in nursing, where practitioners must navigate complex, emotionally charged interactions with patients, families, and colleagues daily. The nursing workforce in Madinah hospitals, including King Fahd Hospital, Ohud Hospital, and Madinah Maternity and Children Hospital, serves a large and diverse patient population that includes pilgrims and residents, presenting distinct emotional and cultural demands that necessitate high levels of emotional competence.

The relationship between EI and nursing performance has attracted considerable scholarly attention. Alsufyani et al. (2022) demonstrated that EI positively impacts nurses' work performance in Saudi Arabia, with occupational stress serving as a key mediating variable. More recently, Cheraghi et al. (2025) confirmed a direct positive effect of EI on job performance ($\beta = 0.099$) and a significant reduction in occupational stress ($\beta = -0.316$). At the international level, a systematic review and meta-analysis by Kawashima et al. (2025), encompassing 23 studies and 1,155 participants, found that EI training significantly improved EI scores (SMD = 1.76), reduced stress (SMD = −1.51), and enhanced communication skills (SMD = 2.72) among nurses and nursing students. Similarly, Powell et al. (2024) reviewed EI training across the healthcare workforce and found that all included studies demonstrated an increase in EI following the intervention, with RCTs showing a significant positive effect (SMD = 1.51, $p < 0.01$).

Despite this growing body of evidence, structured EI training programs remain underutilized in many Saudi Arabian healthcare institutions. A recent assessment of nurses in Jeddah by Alhakami and Baker (2025) found only moderate overall EI scores (3.3/5.0), with self-control and emotionality scoring particularly low, highlighting the urgent need for targeted training. In the critical care context, Aljanfawi et al. (2026) confirmed a positive relationship between EI and job performance among critical care nurses in Saudi Arabia, while Fattah et al. (2023) reported that an EI training program significantly reduced burnout among critical care nurses. Furthermore, Altalhi and Alilyyani (2025) found that EI is significantly associated with resilience and reduced turnover intention among emergency nurses in Saudi Arabia. These findings underscore the clinical and organizational relevance of EI in the Saudi nursing context. Empirical studies focusing specifically on Madinah hospitals, however, remain scarce, representing a significant gap in the literature that this study seeks to address.

Review of Related Literature

Emotional intelligence (EI), as conceptualized by Goleman (1995), refers to the ability to perceive, understand, and manage emotions effectively, and it has become an essential competency in nursing practice. In healthcare settings, particularly in Saudi Arabia, growing evidence highlights the significant role of EI in enhancing nurses' performance and wellbeing. Studies have shown that EI is positively associated with job performance, as nurses with higher emotional competence demonstrate better communication, clinical decision-making, and teamwork (Alsufyani et al., 2022; Aljanfawi et al., 2026). Furthermore, EI contributes to reduced occupational stress, which is a critical factor influencing performance and patient care outcomes (Cheraghi et al., 2025). Research conducted in Saudi Arabia also indicates that nurses often exhibit moderate levels of EI, suggesting a need for structured training programs to improve emotional skills (Alhakami & Baker, 2025).

Additionally, EI has been linked to increased resilience and reduced turnover intention among nurses, highlighting its importance for workforce stability and retention (Altalhi & Alilyyani, 2025). Training interventions have demonstrated substantial benefits, including reduced burnout and improved leadership and professional development (Fattah et al., 2023; Frias et al., 2021). Systematic reviews further confirm that EI training significantly enhances emotional competence, stress management, and communication skills among healthcare professionals (Kawashima et al., 2025; Powell et al., 2024). Overall, the literature underscores EI as a critical factor in improving healthcare quality and nursing outcomes.

Objectives

This study is further motivated by the goals of Saudi Vision 2030, which places significant emphasis on transforming the healthcare sector by improving quality, patient safety, and workforce competence. Investing in EI training programs for nurses represents a strategic approach to achieving these national healthcare goals. The aim of this study is to evaluate the impact of a structured EI training program on nursing performance in hospitals in Madinah. Specifically, the study objectives are: (1) to assess the baseline level of EI among nurses in selected Madinah hospitals; (2) to design and implement a structured EI training program based on Goleman's five-component model (self-awareness, self-regulation, motivation, empathy, and social skills); (3) to measure the effect of the training program on key nursing performance indicators, including patient satisfaction, clinical decision-making, communication, teamwork, and stress management; (4) to examine the relationship between post-training EI scores and nursing performance outcomes; and (5) to provide evidence-based recommendations for integrating EI training into ongoing professional development programs in Madinah hospitals.

Methodology

Study Design and Setting

A quasi-experimental pre-test/post-test design with a control group was employed to evaluate the impact of the EI training program on nursing performance. This design was selected as widely used and appropriate for evaluating educational interventions in clinical settings where randomization is not always feasible (Fattah et al., 2023). The study was conducted in three major hospitals in Madinah, Saudi Arabia: King Fahd Hospital, Ohud Hospital, and Madinah Maternity and Children Hospital. These hospitals were selected based on their large nursing workforce and their role in serving the diverse patient population of the Madinah region.

Participants

A total of 120 registered nurses were recruited using stratified random sampling, with 60 nurses allocated to the intervention group and 60 to the control group. Stratification was based on the hospital and department to ensure proportional representation. Inclusion criteria required participants to hold a valid nursing registration, have more than 1 year of clinical experience, and be employed full-time. Nurses who were on extended leave or had previously participated in a formal EI training program were excluded. Table 1 presents the demographic characteristics of both groups.

Intervention

The intervention consisted of a structured 8-week EI training program, with weekly 2-hour sessions delivered to the intervention group. The curriculum was developed based on Goleman's (1995) five-component model of EI and was informed by the evidence-based training frameworks reviewed in the literature. Each session addressed one of the five core EI competencies: self-awareness, self-regulation, motivation, empathy, and social skills. Training methods included interactive workshops, role-playing exercises, reflective journaling, case-based discussions, and group activities. The control group received no EI training during the study period and continued with their standard professional development activities.

Data Collection Instruments

Data were collected at two time points: before the intervention (pre-test) and immediately after the 8-week program (post-test). Four validated instruments were used. The Trait Emotional Intelligence Questionnaire (TEIQue) was used to measure overall EI and its four sub-factors: well-being, self-control, emotionality, and sociability. The Nursing Performance Scale (NPS) assessed clinical performance across domains, including clinical skills, communication, teamwork, and professional behavior. The Nursing Stress Scale (NSS) measured the frequency of occupational stress. The Patient Satisfaction with Nursing Care Quality Questionnaire (PSNCQQ) assessed patient satisfaction with the nursing care received. All instruments had established reliability and validity and were administered in Arabic.

Analysis

Data were analyzed using IBM SPSS Statistics version 26. Descriptive statistics (mean, standard deviation, frequencies, and percentages) were used to summarize demographic and outcome variables. Paired samples t-tests were used to compare pre- and post-test scores within each group, while independent samples t-tests were used to compare post-test scores between the intervention and control groups. Pearson correlation analysis was conducted to examine the relationships between post-training EI scores, nursing performance, and occupational stress. Multiple linear regression was used to identify predictors of post-training nursing performance. A significance level of $p < 0.05$ was adopted for all statistical tests.

Table 1. Demographic Characteristics of Intervention and Control Groups.

Characteristic	Intervention Group (n=60)	Control Group (n=60)	p-value
Age (years), Mean ± SD	31.4 ± 5.2	32.1 ± 5.8	0.52
Gender: Female	48 (80%)	46 (76.7%)	0.64
Gender: Male	12 (20%)	14 (23.3%)	0.64
Nationality: Saudi	22 (36.7%)	24 (40%)	0.71
Nationality: Non-Saudi	38 (63.3%)	36 (60%)	0.71
Education: Diploma	18 (30%)	20 (33.3%)	0.69
Education: Bachelor's	36 (60%)	34 (56.7%)	0.72
Education: Postgraduate	6 (10%)	6 (10%)	1.00
Experience (years), Mean ± SD	7.3 ± 4.1	7.8 ± 4.5	0.55
Department: Medical/Surgical	24 (40%)	22 (36.7%)	0.71
Department: Critical Care	18 (30%)	20 (33.3%)	0.69
Department: Obstetrics/Pediatrics	18 (30%)	18 (30%)	1.00

Findings and Discussion

Baseline Characteristics

As presented in Table 1, the two groups were comparable at baseline with no statistically significant differences in age, gender, nationality, educational level, years of experience, or department distribution ($p > 0.05$ for all variables). The mean age of participants was 31.4 ± 5.2 years in the intervention group and 32.1 ± 5.8 years in the control group. Most of the participants in both groups were female (80% and 76.7%, respectively) and held a bachelor's degree in nursing (60% and 56.7%, respectively). The mean years of experience were 7.3 ± 4.1 and 7.8 ± 4.5 for the intervention and control groups, respectively. This baseline equivalence supports the validity of subsequent between-group comparisons.

Pre- and Post-Training Outcomes

Table 2 presents the pre- and post-training scores for all outcome measures in both groups. The intervention group demonstrated statistically significant improvements across all outcomes following the 8-week EI training program, while the control group showed no significant changes.

Table 2. Pre- and Post-Training Outcome Measures for Intervention and Control Groups

Outcome Measure	Intervention Pre-test	Intervention Post-test	Control Pre-test	Control Post-test	p-value*
TEIQue Global Score	3.2 ± 0.31	3.8 ± 0.28	3.1 ± 0.29	3.2 ± 0.30	**<0.001**
Self-Awareness	3.1 ± 0.35	3.9 ± 0.27	3.0 ± 0.33	3.1 ± 0.34	**<0.001**
Self-Regulation	3.0 ± 0.38	3.7 ± 0.31	3.0 ± 0.36	3.1 ± 0.35	**<0.001**
Empathy	3.3 ± 0.29	3.9 ± 0.25	3.2 ± 0.31	3.3 ± 0.30	**<0.001**
Social Skills	3.2 ± 0.33	3.8 ± 0.28	3.1 ± 0.32	3.2 ± 0.31	**<0.001**
NPS (Nursing Performance)	72.4 ± 8.3	86.7 ± 7.1	71.8 ± 8.6	72.5 ± 8.4	**<0.001**
NSS (Occupational Stress)	58.3 ± 9.2	44.1 ± 8.6	57.9 ± 9.5	57.2 ± 9.3	**<0.001**
Patient Satisfaction (PSNCQQ)	74.2 ± 6.8	84.5 ± 5.9	73.8 ± 7.1	74.1 ± 7.0	**<0.001**

*Note. *p-value for between-group difference at post-test (independent samples t-test). NPS = Nursing Performance Scale; NSS = Nursing Stress Scale; PSNCQQ = Patient Satisfaction with Nursing Care Quality Questionnaire; TEIQue = Trait Emotional Intelligence Questionnaire.*

Impact on Emotional Intelligence Scores

Post-training TEIQue global scores in the intervention group increased significantly from a mean of 3.2 ± 0.31 to 3.8 ± 0.28 ($p < 0.001$), while the control group showed no significant change (3.1 ± 0.29 to 3.2 ± 0.30). Significant improvements were observed across all five EI sub-components, with the largest gains in self-awareness (3.1 to 3.9) and empathy (3.3 to 3.9). These findings are consistent with the meta-analytic evidence of Kawashima et al. (2025), who reported a standardized mean difference of 1.76 for EI improvement following training in a sample of 1,155 nurses and nursing students. Similarly, Powell et al. (2024) found that all studies in their meta-analysis reported an increase in EI following healthcare workforce training, with RCTs yielding an SMD of 1.51. The present findings thus add to the growing body of evidence supporting the effectiveness of structured EI training in clinical nursing contexts.

Impact on Nursing Performance

NPS scores improved significantly in the intervention group, rising from 72.4 ± 8.3 to 86.7 ± 7.1 ($p < 0.001$), while the control group remained stable (71.8 ± 8.6 to 72.5 ± 8.4). This represents a clinically meaningful improvement of approximately 14.3 points, reflecting enhanced clinical skills, communication, teamwork, and professional behavior. The strong positive correlation between post-training EI scores and nursing performance ($r = 0.68$, $p < 0.001$) suggests that the improvement in performance was substantially mediated by increases in EI. This finding aligns with Alsufyani et al. (2022), who demonstrated a positive relationship between EI and work performance in Saudi nurses, and with Aljanfawi et al. (2026), who confirmed this relationship specifically among critical care nurses in Saudi Arabia. The improvement in performance across all five EI

domains suggests that a comprehensive, multi-component training approach is more effective than targeting a single EI competency in isolation (Chatzidimitriou et al., 2025).

Reduction in Occupational Stress

NSS scores decreased significantly in the intervention group, from 58.3 ± 9.2 to 44.1 ± 8.6 ($p < 0.001$), indicating a meaningful reduction in occupational stress. The control group showed no significant change (57.9 ± 9.5 to 57.2 ± 9.3). A significant negative correlation was observed between post-training EI scores and occupational stress ($r = -0.54$, $p < 0.001$), suggesting that higher EI is associated with greater resilience to workplace stressors. This finding is particularly critical in the context of Madinah hospitals, where nurses manage high-stress situations involving critically ill patients and pilgrims during the Hajj and Umrah seasons. The result corroborates the findings of Cheraghi et al. (2025), who demonstrated a significant direct effect of EI on reducing occupational stress ($\beta = -0.316$) in Iranian nurses, and of Alsufyani et al. (2022), who identified occupational stress as a key mediator between EI and work performance in Saudi Arabia. Furthermore, the reduction in stress is consistent with the meta-analytic findings of Kawashima et al. (2025), who reported an SMD of −1.51 for stress reduction following EI training.

Impact on Patient Satisfaction

Patient satisfaction scores (PSNCQQ) improved significantly in wards where the intervention group worked, rising from 74.2 ± 6.8 to 84.5 ± 5.9 ($p < 0.001$), while scores in control wards remained stable (73.8 ± 7.1 to 74.1 ± 7.0). This improvement of approximately 10.3 points underscores the direct clinical value of EI training for patient outcomes. As noted by Chatzidimitriou et al. (2025), EI enhances patient care through better ethical practice, empathic communication, and more effective therapeutic relationships. The finding that improvements in patient satisfaction were concurrent with improvements in nurse EI and performance provides strong support for the clinical relevance of this intervention. This is particularly significant in the Madinah context, where patient-centered care for a diverse, multicultural population is a key quality indicator.

Conclusion

This study provides compelling evidence that a structured 8-week EI training program can significantly improve nursing performance, enhance patient satisfaction, and reduce occupational stress in the demanding context of Madinah hospitals. The intervention produced statistically significant and clinically meaningful improvements across all measured outcomes, validating the efficacy of targeted emotional skills development in a clinical setting. The strong correlations between post-training EI and both nursing performance ($r = 0.68$) and stress reduction ($r = -0.54$) suggest that EI is a fundamental driver of professional nursing effectiveness.

Based on these findings, it is recommended that nursing administrators and hospital managers in Madinah invest in systematic EI development as a core component of their workforce strategy, in alignment with the goals of Saudi Vision 2030. Integrating EI training into nursing orientation programs, continuing education curricula, and leadership development initiatives can yield substantial returns in patient outcomes, staff well-being, and organizational performance. Particular attention should be paid to self-control and emotionality, which were identified as areas of relative weakness in the Saudi nursing workforce (Alhakami & Baker, 2025).

The study has several limitations that should be acknowledged. The quasi-experimental design, while appropriate for this context, does not allow for complete causal inference due to potential confounding variables. The study was conducted in only three hospitals in Madinah, which may limit the generalizability of findings to other regions of Saudi Arabia. The relatively short duration of the training program (8 weeks) may not capture the full long-term effects of EI development, and longitudinal follow-up studies are recommended. Social desirability bias may have influenced participants' self-reported responses, and the predominantly expatriate nursing workforce may have responded differently to the training due to cultural factors. Future research should explore the long-term sustainability of EI training effects, develop culturally adapted training materials for the diverse Saudi nursing workforce, and investigate the optimal duration and delivery modalities for EI training in healthcare settings.

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Evaluation of Treatment Satisfaction among Type 2 Diabetes Patients in Saudi Arabia

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Abstract

This study proposal evaluates treatment satisfaction among Type 2 diabetes patients in Saudi Arabia, focusing on their experiences with medication and the factors influencing satisfaction levels. The study aims to evaluate the level of patient satisfaction at a diabetic and endocrine centre-Hail and the factors that relate to the satisfaction level. A cross-sectional study was conducted from October 15, 2025, to December 15, 2025, involving 80 patients selected through purposive sampling. Data collection included sociodemographic and clinical information together with Treatment Satisfaction Questionnaire for Medication scale TSQM version (1.4). Results indicate varied satisfaction levels, with only 28.7% of participants satisfied with their medication's effectiveness and a significant 62.6% expressing some degree of dissatisfaction. Factors affecting satisfaction included reported side effects, difficulties in medication use, and challenges in planning administration. While many patients expressed confidence in their medication, convenience ratings were polarized, emphasizing the need for tailored interventions. The study recommends that the diabetic and endocrine centre-Hail should address patients' concerns regarding treatment efficacy and side effects, providing clearer guidance to enhance overall treatment satisfaction.

Keywords: Assessment, Blockchain; Patients, Treatment Satisfaction, Type 2 Diabetes

Introduction

Diabetes mellitus (DM) continues to be among the most common public health globally, with an alarming rise in incidence rates in various regions. According to Alam et al. (2021), diabetes is one of the most pressing health concerns, particularly in the Kingdom of Saudi Arabia (KSA), which is ranked second in the Middle East and seventh worldwide in the sheer number of diabetes cases reported (Al Anazi et al., 2021). Over the past three years, the prevalence of diabetes in KSA has surged tenfold, reaching an alarming 30% of the population (Al Anazi et al., 2021). This rapid escalation of diabetes cases correlates with serious health ramifications, including diminished overall health, reduced quality of life, and increased mortality rates (Abdulaziz Al Dawish et al., 2016).

Patient's satisfaction is a cornerstone of the medical care quality and an important goal of health care providers. Patients' relationships and satisfaction with health care providers are necessary for follow-up and management of the case (Mohamed et al., 2015). The dynamics of patient-provider relationships profoundly influence treatment outcomes, especially for chronic conditions requiring continuous management, such as diabetes.

Research suggests that dissatisfaction among diabetic patients is often linked to variables that undermine their quality of life, including the nature and quality of care received (Ragheb et al., 2016). Moreover, a robust body of literature reviews supports a direct relationship between patient satisfaction and optimal healthcare outcomes, underscoring the need for effective communication and engagement strategies within the healthcare system (Al Anazi et al., 2019).

While existing studies have highlighted factors influencing diabetic patients' satisfaction, gaps remain in understanding how specific demographic and clinical characteristics impact satisfaction levels within the Northern Borders region of KSA. Variables such as gender, age, duration of illness, treatment regimens, and healthcare accessibility can significantly shape the patient experience and satisfaction (Elwan, 2019; Gomaa et al., 2023). Given the important need to enhance diabetes care and patient satisfaction in this underserved region, this study will evaluate treatment satisfaction among type 2 diabetes patients at the diabetic and endocrine center-Hail in Saudi Arabia, and to assess the relationship between patients' satisfaction and their diabetic control.

Problem Statement

Access to diabetes services is important for people with DM patients to achieve wellbeing and Quality of Life (QoL) and reduce morbidity, mortality, and complications. In a fragmented health system like the KSA, where resources are limited and health problems are complex, access to services might be even more complicated than anywhere (Daloul, 2024).

Despite the recognized significance of patient satisfaction in healthcare delivery, there is limited research focusing explicitly on the experiences of type 2 diabetes patients in Saudi Arabia. This research aims to evaluation of treatment satisfaction among type 2 diabetes patients in Saudi Arabia by identifying key determinants of treatment satisfaction, including demographic, clinical, and healthcare-related variables. Furthermore, the research will explore the relationship between these determinants and levels of glycemic control among diabetic patients. Given the pressing need for thorough evaluations of patient satisfaction, this study aims to contribute valuable insights that can inform and enhance diabetes management strategies in the Northern Borders region of Saudi Arabia, ultimately leading to improved health outcomes.

Review of Related Literature

Diabetes mellitus (DM) is a significant public health concern globally and in developing countries, and effective management is imperative for improving patient treatment and satisfaction. Nurse care at diabetes centers has emerged as a vital approach to managing this chronic condition, particularly given the rising prevalence of diabetes in populations worldwide, including Saudi Arabia. Nurses qualified as Nurse Independent Prescribers (NIPs) can assess, diagnose, and prescribe independently any licensed medicine (and some controlled drugs).

This literature review that evaluates treatment satisfaction among patients with type 2 diabetes (T2D) attending diabetes centers. The studies highlight various factors contributing to patient satisfaction and their implications for diabetes management.

This online search was supplemented by an extensive hand search of the literature through references identified from retrieved articles, regionally and in Saudi Arabia, so we start

from research conducted in Sub-Saharan Africa by McCoy, L., & Thew, J. (2019), The Role of Nurse Clinics in Managing Type 2 Diabetes: A Systematic Review. Sample: 32 studies (various countries) comprising 4,500 patients globally, show that: This comprehensive review found that nurse clinics significantly improved glycemic control and patient satisfaction. The study reported that patients managed under nurse programs had better HbA1c levels compared to those receiving standard care, indicating that structured nurse interventions can enhance diabetes management.

A study published in 2020 conducted Diabetes clinic in Italy, a cross-sectional study involving sample size 250 T2D patients at a diabetes clinic. The researchers utilized the Diabetes Treatment Satisfaction Questionnaire (DTSQ) to assess satisfaction levels. Their findings revealed that 62% of participants reported high treatment satisfaction, strongly correlating with better glycemic control (Bonsignore et al., 2020). Strengths: Utilized the validated Diabetes Treatment Satisfaction Questionnaire (DTSQ) for measurement, providing reliable data on patient satisfaction. While limitations of this study cross-sectional design limits causal inferences; the study may not represent the broader population of T2D patients.

A study was conducted at diabetes care centers in South Korea by Lee et al. (2021), Mixed-methods approach involving sample size 300 T2D patients, The results showed that, higher engagement in self-management activities led to significantly improved satisfaction scores, emphasizing the importance of supportive healthcare provider interactions (Lee et al., 2021). Strengths of this study, Mixed-methods approach allowed for comprehensive insights into patient experiences and engagement, while limitations that, Potential bias in self-reported data; the sample may not reflect all demographic groups.

Another study conducted in Saudi Arabia by (Al Anazi et al., 2019) To determine type 2 diabetic patients' satisfaction with the services provided by the diabetic and endocrine center-Hail, and to assess the relationship between patients' satisfaction and their diabetic control. An observational cross-sectional study, carried out in 322 patients at the diabetic and endocrine center-Hail, Arar, Kingdom of Saudi Arabia between January and April 2018. A systematic random sampling technique was applied. Two-thirds of the patients were overall satisfied to both self-reported health status and mode of treatment by the diabetic and endocrine center-Hail, Saudi Arabia. The study recommends emphasis on patient education and addressing patient needs and worries.

Another study conducted by Harper et al. (2024) in the United States, conducted a longitudinal study assessing changes in treatment satisfaction over two years among 150 T2D patients. The findings indicated that ongoing support and regular treatment with healthcare providers and frequent adjustments to treatment plans were associated with sustained high levels of treatment satisfaction (Harper et al., 2024). Strengths of this study: Longitudinal design allows for tracking changes in treatment satisfaction over time, providing a dynamic view of patient experiences. And limitations potential loss to follow-up may affect the reliability of longitudinal data; results may not be applicable to patients with different healthcare access.

After reviewing five different articles from various countries, 1 of these articles was A Systematic Review, 2 was a cross-section study, 1 was mixed-methods approach and 1 was Longitudinal design. The reviewed studies collectively underscore the multifaceted

nature of treatment satisfaction among T2D patients in diabetes centers globally and specifically within Saudi Arabia. Key factors influencing satisfaction include personal engagement in treatment, socio-demographic variables, the effectiveness of educational programs, and the quality of communication between patients and healthcare providers. Recognizing and addressing these factors can enhance treatment satisfaction, ultimately leading to better health outcomes for patients with type 2 diabetes.

Objectives

Aim of the Study

The study aims to evaluate of treatment satisfaction among type 2 diabetes patients in Saudi Arabia.

I. To measure patient's satisfaction level at diabetic and endocrine center-Hail in Saudi Arabia.
II. To explore factors affecting patient's satisfaction level.

Research Questions

1. What is the level of treatment satisfaction among type 2 diabetes patients in Saudi Arabia?
2. What factors significantly influence this satisfaction?

Methodology

Study Design and Setting

This is a cross-sectional study that was conducted in Diabetes and Endocrine Centers -Hail, KSA, between the October 15, 2025 to December 15, 2025.

Target Population

The population for this study includes all patients diagnosed with diabetes mellitus who receive care at Diabetes and Endocrine Centres -Hail, KSA. This includes patients with type 2 diabetes between 18 and 65 years, representing a diverse demographic background. This age range is selected to facilitate a comprehensive understanding of treatment satisfaction among type 2 diabetes patients.

Eligibility Criteria

To ensure that the study findings are relevant and applicable, specific eligibility criteria will be established. These criteria include:

Inclusion Criteria:

- Patients aged 18 to 65 years.
- Patients diagnosed with type 2 diabetes.
- Patients are currently receiving care at the Diabetes and Endocrine Centers -Hail in Saudi Arabia.
- Patients who have agreed to participate in the study.

Exclusion Criteria:

- Patients with severe complications (e.g., advanced retinopathy, nephropathy) that can skew the results.
- Patients diagnosed with type 1 diabetes.

- Patients with gestational diabetes.
- Any individual who has been diagnosed with diabetes for less than six months.
- Patients who were unable to provide informed consent due to cognitive impairment.

Samples and Sampling

A non-probability purposive sampling method will be employed for this study. This approach allows researchers to select participants who meet specific criteria.

Sample Size:

To estimate the expected sample size, we will use a formula to calculate the sample size for the proportions. The formula is as follows:

To determine the appropriate sample size for the study, we will employ a statistical formula for estimating proportions. Assuming we aim for a 95% confidence level and a 5% margin of error, the formula for calculating the sample size n is given by:

$$n = \frac{z^2 \cdot p \cdot (1-p)}{e2}$$

Where:

- n = required sample size
- Z = Z-value (e.g., 1.96 for a 95% confidence level)
- p = estimated proportion of the population (for example, prevalence of patients with diabetes using nurse-led care)
- e = margin of error (e.g., 0.05)

$$n = \frac{(0.05)^2(1.96)^2 \cdot 0.5 \cdot (1-0.5)}{(0.05)^2}$$

$$n = \frac{3.8416 \cdot 0.5 \cdot (0.5)}{0.0025}$$

$$n = \frac{0.9604}{0.0025} = 384.16$$

Thus, by rounding up, the expected sample size will be **385** participants.

Sampling Technique

Out of diabetic and endocrine center-Hail in KSA. one was purposive sampling selected, from 80 patients. The participants were selected by using online method of purposive sampling technique.

Data Collection Tool

Data were collected by the researcher over a two-month period, from October 15, 2025 to December 15, 2025, at the Diabetic Center in Northern Border Province, Saudi Arabia. The study involved administering questionnaires designed to assess patient satisfaction and adherence via an online platform. The assessment was self-administered, with each questionnaire taking approximately 8 to 10 minutes to complete. The questionnaires utilized in this study were informed by research, including the validation of the Treatment Satisfaction Questionnaire for Medication (TSQM-1.4) among patients on diabetic medications, as demonstrated by Bharmal et al. (2009), who highlighted its relevance for evaluating patient satisfaction and treatment adherence.

Study Instruments

The form used in this study included two sections: section one, demographic and clinical information; section two, the Treatment Satisfaction Questionnaire for Medication (TSQM) version (1.4) (Atkinson et al., 2004). Both questionnaires are validated and have been shown to have good reliability and validity, and the translated Arabic versions are suitable and acceptable to be used in the Arab-speaking world. The researcher used the Arabic version of the TSQM from. The TSQM-1.4 includes four essential domains of satisfaction with medications: effectiveness (items 1–3), side effects (items 4–8), convenience (items 9–11), and global satisfaction (items 12). The domain scores were calculated as recommended by the instrument's author (Bharmal et al., 2009). The scores for the domains ranged from 0 (extremely dissatisfied) to 100 (extremely satisfied).

Analysis

Data entry and analysis was performed with the Statistical Package for the Social Sciences (SPSS), version 27.0. Descriptive statistics consisted of means and standard deviations for numerical data and frequencies and percentages for categorical data. Relationships between categorical variables were evaluated by chi-squared test, and associations between means of continuous variables by independent t-tests. P-values $\leq$ 0.05 were statistically significant.

Administrative and Ethical Considerations

Research approval was obtained from the Research Ethical Committee of Northern Borders General Health Affairs. Administrative approval was obtained from administration of diabetic and endocrine centre-Hail, KSA. Before the participants were informed about the study, and verbal informed consent was taken. They were assured that the data collected was kept strictly confidential and that personal identifying information will not be published.

Table 1. Distribution of the study participants according to their socio-demographic characteristics and health-related variables (n=80).

Socio-demographic variables		Number n	Percentage %
Age in years	18-28	30	37.5%
	29-40	50	62.5%
	41-65	0	0.0%
Gender	Male	8	10.0%
	Female	72	90.0%

Marital status	Married	27	33.8%
	Unmarried	53	66.3%
Place of Residence	Rural	69	86.3%
	Urban	11	13.8%
Education level	Secondary or less	23	28.7%
	More than secondary	57	71.3%
Occupation	Working	45	56.3%
	Not working	35	43.8%
Smoking status	Smoke	8	10.0%
	Non-smoker	72	90.0%
Health insurance	Yes	30	37.5%
	No	50	62.5%
Income monthly	Just enough	69	86.3%
	Not enough	11	13.8%

The study analyzed the socio-demographic characteristics of 80 patients, revealing notable trends within the sample. The majority of participants (62.5%) were aged 29-40 years, followed by 37.5% in the 18-28 age group, with no representation in the 41-65 age range. Gender distribution was showed, with females comprising 90.0% of the sample and males only 10.0%. In terms of marital status, 66.3% were unmarried, while 33.8% were married. Most participants (86.3%) resided in rural areas, with only 13.8% living in urban settings. Education levels indicated that 71.3% had achieved more than secondary education, compared to 28.7% with secondary education or less. Employment data showed a slight majority (56.3%) were working, while 43.8% were not. Smoking prevalence was low, with 90.0% identifying as non-smokers and just 10.0% as smokers. Health insurance coverage was reported by 37.5%, leaving a majority of 62.5% uninsured. Regarding monthly income, 86.3% stated it was "just enough," while 13.8% reported it as "not enough." These findings highlight a predominantly young, female, educated, and rural demographic, with low smoking rates, limited health insurance, and generally sufficient income among the participants.

Table 2: Distribution of the study participants according to their treatment satisfaction questionnaire for medication (TSQM 1.4)

Items		**Number n**	**Percentage %**
How satisfied or dissatisfied are you with the ability of the medication to prevent or treat your condition?	Extremely Dissatisfied	23	28.7%
	Very Dissatisfied	0	0.0%
	Dissatisfied	12	15.0%
	Somewhat Satisfied	22	27.5%
	Satisfied	23	28.7%
	Very Satisfied	0	0.0%
	Extremely Satisfied	0	0.0%
How satisfied or dissatisfied are you with the amount of time it takes the medication to start working?	Extremely Dissatisfied	12	15.0%
	Very Dissatisfied	19	23.8%

	Dissatisfied	23	28.7%
	Somewhat Satisfied	15	18.8%
	Satisfied	0	0.0%
	Very Satisfied	0	0.0%
	Extremely Satisfied	11	13.8%
As a result of taking this medication, do you experience any side effects at all?	Yes	26	32.5%
	No	54	**67.5%**
How bothersome are the side effects of the medication you take to treat your condition?	Extremely Bothersome	0	0.0%
	Very Bothersome	11	13.8%
	Somewhat Bothersome	22	27.5%
	A Little Bothersome	47	**58.8%**
	Not at All Bothersome	0	0.0%
To what extent do the side effects interfere with your physical health and ability to function (i.e., strength, energy levels, etc.)?	A Great Deal	11	13.8%
	Quite a Bit	0	0.0%
	Somewhat	38	47.5%
	Minimally	31	38.8%
	Not at All	0	0.0%
To what degree have medication side effects affected your overall satisfaction with the medication?	A Great Deal	0	0.0%
	Quite a Bit	19	23.8%
	Somewhat	50	**62.5%**
	Minimally	11	13.8%
	Not at All	0	0.0%
How easy or difficult is it to use the medication in its current form?	Extremely Difficult	12	15.0%
	Very Difficult	0	0.0%
	Difficult	11	13.8%
	Somewhat Easy	32	**40.0%**
	Easy	25	31.3%
	Very Easy	0	0.0%
	Extremely Easy	0	0.0%
How easy or difficult is it to plan when you will use the medication each time?	Extremely Difficult	0	0.0%
	Very Difficult	12	15.0%
	Difficult	35	**43.8%**
	Somewhat Easy	14	17.5%
	Easy	19	23.8%
	Very Easy	0	0.0%
	Extremely Easy	0	0.0%
How convenient or inconvenient is it to take the medication as instructed?	Extremely Difficult	0	0.0%
	Very Difficult	0	0.0%
	Difficult	24	30.0%
	Somewhat Easy	30	**37.5%**
	Easy	0	0.0%
	Very Easy	0	0.0%

	Extremely Easy	26	32.5%
Overall, how confident are you that taking this medication is a good thing for you?	Not at All Confident	0	0.0%
	A Little Confident	0	0.0%
	Somewhat Confident	30	37.5%
	Very Confident	42	**52.5%**
	Extremely Confident	8	10.0%
How certain are you that the good things about your medication outweigh the bad things?	Not at All Confident	0	0.0%
	A Little Confident	11	13.8%
	Somewhat Confident	45	**56.3%**
	Very Confident	24	30.0%
	Extremely Confident	0	0.0%
Taking all things into account, how satisfied or dissatisfied are you with this medication?	Extremely Dissatisfied	12	15.0%
	Very Dissatisfied	19	23.8%
	Dissatisfied	19	23.8%
	Somewhat Satisfied	19	23.8%
	Satisfied	11	13.8%
	Very Satisfied	0	0.0%
	Extremely Satisfied	0	0.0%

The analysis of the treatment satisfaction levels among patients reveals a diverse range of experiences regarding their medication. In terms of effectiveness, opinions were mixed, with 28.7% of participants being "Extremely Dissatisfied" and an equal percentage reporting being "Satisfied," while others expressed moderate dissatisfaction or satisfaction. Regarding the time it takes for the medication to start working, dissatisfaction was prevalent, with 28.7% "Dissatisfied" and 23.8% "Very Dissatisfied," while only 13.8% were "Extremely Satisfied." Side effects were reported by 32.5% of participants, with most finding them "A Little Bothersome" or "Somewhat Bothersome," and only a small fraction experiencing significant interference with their physical health. Ease of use posed challenges, as 40.0% rated it as "Difficult" and no participants found it "Easy" or "Very Easy." Planning medication usage was similarly challenging, with 43.8% finding it "Difficult," though 23.8% rated it as "Easy." Despite these challenges, medication convenience received more favourable responses, with 37.5% finding it "Somewhat Easy" and 32.5% "Extremely Easy." Confidence in the medication was generally high, with 52.5% "Very Confident" and 10.0% "Extremely Confident," though 37.5% were only "Somewhat Confident." Overall satisfaction was limited, as dissatisfaction dominated, with 23.8% each "Very Dissatisfied" or "Dissatisfied" and only 13.8% "Satisfied." These findings highlight the need for improvements in medication effectiveness, ease of use, and patient support to enhance overall satisfaction and treatment adherence.

In conclusion, the study underscores the complexity of patient satisfaction in the treatment of type 2 diabetes. Addressing both the clinical effectiveness of medications and the practical challenges faced by patients is crucial to improving their overall satisfaction and treatment adherence.

Findings and Discussion

Patient satisfaction is the key indicator of quality medical care. Patient satisfaction with the nurse- patient interaction is directly attributed to the level of a doctor's competence and success in service provision (Al Anazi et al., 2021). This is an observational cross-sectional study conducted on 80 type 2 diabetic patients attending diabetic and endocrine centre-Hail in Kingdom Saudi Arabia. This study aims to evaluate of treatment satisfaction among type 2 diabetes centre of Northern Border province, KSA. The findings from this study provide critical insights into treatment satisfaction among Type 2 diabetes patients in Northern Border province, highlighting significant trends and areas for improvement. The socio-demographic analysis revealed that the majority of participants were young females (62.5% aged 29-40 years, 90% female), predominantly living in rural areas (86.3%) with a high level of education (71.3% having more than secondary education). This demographic profile aligns with previous studies indicating that younger, educated women are increasingly affected by Type 2 diabetes (Tanveer et al., 2021). However, the low representation of older patients (41-65 years) suggests a need for targeted outreach to this age group, as they may also be at risk.

Interpretation of the study aim and objectives based on the results

The study aimed to evaluate treatment satisfaction among type 2 diabetes patients, focusing on their experiences with medication and factors influencing satisfaction levels. The results provide valuable insights into the study objectives:

Objective I: To measure patient satisfaction levels at the diabetic and endocrine centre-Hail, KSA

The findings reveal varied levels of satisfaction among patients, with significant dissatisfaction regarding the effectiveness of the medication and the time it takes to start working. While 28.7% of participants expressed satisfaction with the ability of the medication to treat their condition, dissatisfaction remained high, with 28.7% "Extremely Dissatisfied" and 15.0% "Dissatisfied." Similarly, only a small proportion (13.8%) were "Extremely Satisfied" with the time taken for the medication to act, indicating room for improvement in treatment regimens and patient education. This finding supports existing literature indicating that treatment effectiveness is a crucial determinant of patient satisfaction (Bidaut-Russell et al., 2020). Overall satisfaction was notably low, with a combined 62.6% of patients expressing some degree of dissatisfaction, suggesting that the center needs to address patients' concerns and expectations more effectively. This finding is consistent with research indicating that dissatisfaction with treatment can lead to poor adherence and negative health outcomes (Ala'Eddin et al., 2016). Therefore, addressing these concerns is vital for improving treatment adherence and patient outcomes.

Objective II: To explore factors affecting patient satisfaction levels

The analysis highlights multiple factors influencing patient satisfaction. Side effects, though not universally experienced, played a role in shaping perceptions, with 32.5% of participants reporting side effects, of whom a majority found them "Somewhat" or "A Little Bothersome." This aligns with previous studies that have shown side effects can significantly impact patients' perceptions of treatment efficacy (Burnier, M. 2024). Ease of medication use and planning its administration were significant challenges for many, with 40.0% finding it "Difficult" to use the medication and 43.8% struggling to plan its usage. Additionally, confidence in the medication's benefits and convenience levels were mixed; while confidence was generally high, convenience ratings were polarized,

suggesting variability in patient experiences based on personal circumstances or treatment protocols. These factors collectively underline the need for tailored interventions to improve medication accessibility, address side effects, and provide clear guidance to enhance patient satisfaction.

Limitations and Strengths

This study has several limitations that may affect the results and their generalizability. First, observational cross-sectional design limits the possibility to define causality relationships between patient satisfaction and the identified factors. However, the sample size was conducted of 80 patients, while providing initial insights, cannot be generalized to all type 2 diabetic patients in Saudi Arabia. The analysis was made at only one diabetic and endocrine centre-Hail that means that the results cannot be generalized for other regions or health-care centres with different patient population and different health-care practices. However, there are also strengths to consider, the study's focused approach on a specific patient demographic enhances understanding of treatment satisfaction, enabling targeted interventions. The use of the validated Treatment Satisfaction Questionnaire for Medication (TSQM) improves the reliability of the findings.

Recommendations for Future Research

Future research should explore longitudinal changes in satisfaction levels and the effectiveness of implemented interventions. The generalizability of the findings may be improved upon by increasing the sample size and involving several diabetic centres in various regions of Saudi Arabia. Further, more exploratory research methods for example interviews or focus groups, could provide deeper insights into patient experiences and the reasons behind their satisfaction or dissatisfaction.

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Conclusion

In conclusion, this study highlights significant concerns regarding treatment satisfaction among type 2 diabetes patients at the diabetic and endocrine centre-Hail, KSA. The significant dissatisfaction reported by patients, particularly regarding medication effectiveness and ease of use, necessitates immediate attention from healthcare providers. Tailored interventions that focus on patient education, medication management, and addressing side effects are essential for improving patient experiences and treatment outcomes.

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Effect of School Screening Programs SMS Alerts on Parental Health-Seeking Behaviour: A Cross-Sectional Study in Medina, KSA

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Abstract

School health screening programs play an essential role in the early detection of health problems among children and in promoting timely healthcare interventions. Recently, digital communication tools such as Short Message Service (SMS) alerts have been integrated into school health programs to improve parental awareness and encourage appropriate health-seeking behaviour. This study aimed to evaluate the effect of SMS alerts from school screening programs on parental health-seeking behaviour in Medina, Saudi Arabia.

Keywords: Child Health Screening, Digital Health Communication, Early Disease Detection, Mobile Health (Mhealth), Parental Health-Seeking Behaviour, School Health Screening, SMS Alers, School Health Programs, Student Health

Introduction

Schools play a crucial role in children's health and wellbeing by providing health education, early detection of health issues, and promoting healthy habits, which directly impact their learning, social skills, and overall development. Children face various physical health problems like obesity, vision and hearing impairments, dental issues, and mental health concerns such as depression and anxiety, which can hinder their academic performance and quality of life if not identified early. School-based health screening programs are essential for early diagnosis, timely intervention, and raising awareness among students, parents, and teachers, especially in areas with limited healthcare access. The integration of digital tools, such as SMS alerts in Saudi Arabia's National School-Based Screening Program, aims to enhance parental involvement and promote prompt health-seeking behaviour, though more research is needed to evaluate their effectiveness in improving health outcomes.

Review of Related Literature

This study is crucial as it addresses the gap in understanding how parental responses to SMS alerts after school health screenings impact their health-seeking behaviours in Medina. Insights gained will guide policymakers and healthcare providers to optimize digital communication strategies, improve the effectiveness of school health initiatives, and ultimately enhance children's health outcomes through culturally and geographically tailored approaches.

School health screening programs are widely recognized as essential strategies for early identification of physical and mental health problems among children, enabling timely intervention and improved long-term outcomes. Studies in Saudi Arabia have reported a notable prevalence of health conditions such as obesity, vision impairments, and dental issues among school-aged children, reinforcing the importance of systematic screening initiatives (Al Daajani et al., 2021). Early screening has been shown to play a key role in preventive healthcare by identifying health risks before they escalate, thereby reducing disease burden and improving quality of life (Ali & Shah, 2023). Furthermore, schools provide a strategic platform for health promotion and education, as they reach large populations of children and can influence both student and parental behaviours (Elsayed & Almohaithef, 2019; Alzahrani, 2022).

Despite the availability of screening programs, translating health information into positive parental health-seeking behaviour remains a challenge, particularly in developing and middle-income contexts. Behavioural change is influenced by multiple factors, including awareness, socioeconomic status, education, and cultural beliefs (Aboud & Singla, 2012; Ali & Ali, 2023). Communication strategies are therefore crucial in bridging the gap between detection and action. Behaviour changes communication interventions, including reminders and targeted messaging, have proven effective in promoting health-related actions among caregivers when appropriately designed and culturally adapted (Briscoe & Aboud, 2012).

In recent years, digital health communication tools such as Short Message Service (SMS) have emerged as cost-effective methods to enhance healthcare engagement. Mobile health (mHealth) interventions, particularly SMS alerts, have demonstrated success in improving appointment adherence, treatment compliance, and preventive health behaviours due to their accessibility and convenience. Integrating SMS alerts into school health screening programs offers an opportunity to improve parental awareness and responsiveness, especially in regions with high mobile phone penetration. Additionally, public–private partnerships and technological innovations have contributed to improving access to healthcare services and enhancing communication efficiency (Abass et al., 2024).

However, existing literature highlights that the effectiveness of such digital interventions depends on various contextual factors, including literacy levels, socioeconomic disparities, and health system infrastructure. Health-related barriers, including limited awareness and access to services, can significantly impact children's academic performance and overall wellbeing if not addressed promptly (Gracy et al., 2017). While evidence supports the potential of SMS-based communication, there remains a need for context-specific research to evaluate its impact on parental health-seeking behaviour within school health programs in Saudi Arabia, particularly in cities such as Medina.

Objective

Aim of the Research

- To evaluate the effect of school screening programs SMS alerts on parental health-seeking behaviour: a cross-sectional study in medina, KSA

Objectives of the Research

- to estimate the prevalence of obesity, vision problems, scoliosis, depression, and tooth problems among school students in Medina City.

- to determine the response rate of parents to the recommendation by the school health program.
- to determine factors associated with percent of parents who respond to the recommendation sent through SMS from the School health program.

Methodology

Study Design

This study employs an analytical cross-sectional design to determine the prevalence of health issues identified through school health screenings in Medina and to assess parents' responses to SMS alerts about their children's health conditions. It combines analysis of existing screening data with additional information gathered via phone interviews, providing a snapshot of health status and behaviours at a specific point in time.

Setting

The research will be conducted in Medina City, Saudi Arabia, focusing on schools participating in the school health screening program during the 2024-2025 academic year. Data collection will occur from April to December 2025, beginning with the screening data from the previous year, followed by phone interviews with parents of children diagnosed with health abnormalities, involving both school health authorities and families.

Participants

The sample size for parental interviews was determined to be 380 participants, based on expected response rates, estimated parental response prevalence, and the statistical power needed to identify significant associations. To ensure comprehensive prevalence analysis, all students in the population will be included.

Inclusion criteria include students enrolled in Medina schools who were screened during 2024-2025 and their parents or guardians who received SMS notifications about health abnormalities.

Exclusion criteria encompass those who decline participation, cannot be reached after three attempts, or have incomplete screening records.

Sampling methods involve analyzing the total number of students with health issues for prevalence estimates and randomly selecting 380 parents or guardians of children with health problems for feedback, ensuring representative and unbiased results.

Analysis

Participant Demographics: Over 380 parents, mostly males (67.9%) with an average age of 41.2 years; most had tertiary education, were employed, and had chronic diseases, with many being widowed.

Child Characteristics: The average child age was 13.8 years; most were boys in middle school, with a high prevalence of chronic diseases; many children lived only with their father.

Screening & Awareness: Most parents knew about school health visits in advance and received SMS alerts, mainly from schools, which were generally clear and informative.

Actions Taken: Around 66% of parents responded to SMS, primarily visiting health centres and consulting general physicians, despite facing some difficulties.

Communication & Satisfaction: Parents largely reported satisfaction with SMS communication, preferring it as the method, with higher satisfaction linked to older parental age and health issues.

Response Factors: Male parents, those with more children, higher education, employment, and chronic diseases were more likely to respond and take action; age differences were statistically significant.

Findings and Discussion

This study demonstrates that SMS alerts sent through school screening programs significantly influence parental health-seeking behaviours in Medina, KSA. The high response rate (80.3%) and subsequent actions, such as visiting health centres, suggest that SMS is an effective, accessible, and culturally appropriate communication tool that can prompt timely health interventions. Parental factors such as higher education, employment, and existing health conditions were associated with increased responsiveness, highlighting the importance of literacy and socioeconomic status in health engagement. The findings align with previous research supporting SMS as a cost-effective means to improve health behaviours and service utilization, emphasizing its potential for widespread implementation within school health initiatives.

The results underscore the need for standardized, culturally tailored SMS communication strategies, along with targeted approaches for less responsive groups, such as parents with lower literacy levels. Incorporating additional communication methods and health literacy programs could enhance responsiveness and health outcomes further. While promising, the study's cross-sectional design and reliance on self-reported data point to the necessity for longitudinal and controlled studies to confirm causality and evaluate long-term effects.

Conclusion

The study found that SMS notifications from school health screenings significantly influence parental actions in Medina, Saudi Arabia. Mobile health innovations like SMS are affordable, culturally appropriate, and effective in encouraging parents to seek timely health care for their children, such as visiting clinics and following medical advice. SMS alerts notably improved parental responsiveness to child health issues identified during school checkups. Despite concerns about digital divide issues, the strong positive feedback indicates broad applicability and potential for large-scale adoption, emphasizing the importance of integrating SMS into health programs. Policymakers and health practitioners should prioritize embedding SMS communication into national and school health initiatives. Future research should explore long-term impacts, message customization, and strategies to ensure equitable access, ultimately fostering more efficient and inclusive child healthcare locally and globally.

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Effectiveness of A Childhood Fever Awareness Program for Parents and its Impact on Health Literacy at AL-Naqrah PHC, in Ha'il, Saudi Arabia

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Abstract

Childhood fever is one of the most frequent reasons due to which parents seek emergency or primary healthcare services. Still, there are widespread misconceptions related to fever, warning signs, antipyretic use, and home management. Al-Naqrah Primary Healthcare Centre (PHC) in Ha'il emphasizes improving fever awareness in parents to reinforce family-centered care, promoting childhood illness management, and reducing unnecessary consultation. The aim of this scoping review is to explore existing literature on the effectiveness of childhood fever awareness programs and analyses their influence on parent knowledge, health literacy, fever management practices, and confidence. A scoping review methodology adopted in this study helps in identifying, sintering, and presenting relevant educational intervention reports, guidelines, and reviewed studies. The literature related to parent awareness, childhood fever education, health literacy, primary healthcare-based interventions, antipyretic decision-making, and fever phobia will be extracted from electronic databases. Included studies will consist of caregivers or children of parents, semi-structured interventions for fever awareness, and results focusing on knowledge, self-efficacy, attitudes, health literacy, and healthcare-seeking behaviour. Thematic summary of the evidence will help in determining components of intervention, measured outcomes, delivery methods, and gaps related to primary healthcare settings within Saudi Arabia. The expected findings will likely demonstrate improvement in understanding of the parents as a result of fever awareness of programs. This will also help in supporting the use of antipyretics, reducing anxiety, and enhancing identification of concerning signs. This review will offer a basis for adapting or developing a childhood fever awareness program according to the culture at Al-Naqrah PHC.

Keywords: Attitudes, Caregivers, Childhood Fever, Educational Interventions, Fever Management, Health Literacy, Knowledge, Parental Knowledge, Primary Healthcare, Practices, Primary Health Care, Scoping Review

Introduction

This Childhood fever is one of the most common causes of parental worry, emergency consultation, primary healthcare attendance, and telephone advice seeking. Although fever is not a disease and is a regulated physiological response to infection, most parents consider this increase in temperature as inherently dangerous. Modern research evidence consistently highlights inaccurate beliefs regarding fever thresholds, normal temperature, brain damage, antibiotics, seizures, and requirement of urgent medical examination among Saudi parents (Hussain et al., 2020). Clinical significance of these beliefs is high

because they influence antipyretic dosing, home monitoring, fluid encouragement, decisions related to seeking professional care, and cooling practices (Alomari & Alyahya, 2024).

Parental Health Literacy and Fever Awareness

Childhood Fever phobia is a very important concept in childhood fever research. It describes the fear of the parents that serious harm may result from fever if not reduced rapidly. Recent scholarly research shows a close connection of parental anxiety with weak self-efficacy, limited health literacy, and dependence on digital or informal information sources that are usually not accurate (Menekşe et al., 2024). It means that health literacy is not just about reading ability. It also involves the capacity of the parents to access, appraise, understand and implement information related to management of fever in real family situations. Parents with low health literacy may alternate between overtreatment, undertreatment, unnecessary antibiotics, avoidable healthcare visits, unsafe drug combinations and repeated temperature checking. On the other hand, parents with better health literacy can ensure correct antipyretic, calmer decision-making, suitable use of primary healthcare, and recognition of danger signs (Küçük, 2025).

Saudi Primary Healthcare Relevance

The relevance of this topic is particularly high for Al-Naqrah Primary Health Care (PHC) Centre in Ha'il, Saudi Arabia, because families managing childhood illness usually contact the PHC services first. Findings from studies conducted in Saudi settings suggest persistent gaps in knowledge and practice of parents despite their strong access to healthcare services. It suggests that effective home-based fever management is not guaranteed by service availability alone (Al Arifi & Alwhaibi, 2021). Healthcare educators, physicians, and nurses are usually well-positioned in community-based PHC settings to provide structured awareness programs on childhood fever. These programs are designed to address misconceptions that result in access to emergency departments by the families. Such programs may consist of illustrated leaflets, brief counselling, waiting-area education, parent-focused decision aids, and mobile messages. However, evidence related to the most effective components, feasible for Saudi PHC contexts, and culturally acceptable components remains fragmented across cross-sectional surveys, intervention studies, clinical education literature, and reviews (Assi, 2024)

Problem Statement and Need for Evidence Mapping

The central problem focused on this study is that the advice received by the parents from previous clinical encounters, pharmacies, social media, and relatives might be fragmented. Similarly, PHC teams might not have access to consolidated evidence for developing fever education. This results in a practical gap between routine fever decisions by parents and available scientific guidance.

Rationale for the Scoping Review

A scoping review is justified because the field involves a broad range of research designs, educational formats, outcomes, and definitions of health literacy. This paper does not test one specific intervention effect. It rather maps the current knowledge related to childhood fever awareness programs for parents and the influence of these programs on knowledge, confidence, attitudes, health literacy, and practices. The review recognises evidence gaps related to developing a tailored program for Al-Naqrah PHC. The paper synthesises available literature to support a culturally responsive and more systematic approach to

parent fever education. The findings of this research will contribute to a more informed and safer family-oriented primary healthcare for parents, children, health systems, and clinicians.

Review of Related Literature

Childhood Fever as a Primary Healthcare and Parental Concern

Childhood fever is a usual symptom that results in parental concern, use of healthcare service, and home treatment. In clinical terms, fever is an adaptive response to infection, and it does not suggest any severe disease. However, the parents usually consider this elevation in temperature as an immediate threat requiring urgent medical attention. It is necessary to understand this difference because awareness programmes must address emotional responses, knowledge, decision-making, and risk perception. Recent scholarly evidence has highlighted that misconceptions related to thresholds of fever, complications, and necessity of antipyretics is common among populations belonging to various cultures (Sakr et al., 2022). According to Ng et al. (2023), fever education is a matter of global health literacy instead of a problem that is limited to one service delivery setting or a country.

Parental Knowledge and Misconceptions about Fever

Knowledge possessed by the patients about the concept, reasons, and outcomes of fever is usually incomplete. They are usually uncertain regarding the temperature that results in fever, limited association between high fever and severity of illness, and distinction between hypothermia and fever. Hussain et al. (2020) conducted study in the Saudi context and reported gaps in attitudes, knowledge, and practices among parents, including uncertainty related to the methods of measurement and decisions for treating childhood fever. Studies conducted in other countries have also highlighted similar patterns. According to Sakr et al. (2022), the parents believe that the fever causes coma, brain damage, or death if not immediately treated. The parents may perceive the manageable symptoms as an emergency due to these beliefs, increasing pressure on healthcare services.

Fever Phobia, Anxiety, and Health-Seeking Behaviour

Fever phobia is an important factor that describes strong reactions from parents despite clinical reassurance. This phobia is not an outcome of lack of information. It represents a mix of previous illness experiences, fear, cultural beliefs, uncertainty regarding danger signs, and social advice. According to Ng et al. (2023), parental anxiety usually results in checking temperature repeatedly, alternating antipyretics, waking sleeping children for medication, seeking antibiotics, taking children to healthcare facilities sooner than clinically needed, and unnecessarily using tepid sponging. Research conducted in community and emergency settings highlighted moderate educational attainment as a key cause of persistent parental concern. It means that they cannot achieve fever-specific health literacy from general education (Toksoz & Acikgoz, 2024). Therefore, knowledge correction with practical guidance and confidence-building must be combined with effective awareness programmes.

Health Literacy and Fever Management Capacity

Health literacy equips an individual with a theoretical lens to understand fever management by parents. It consists of the ability to understand, obtain, use, and evaluate health information to make informed decisions. According to Menekşe et al. (2024), parental health literacy has a relationship with fever management practices. Findings of

this research suggest the impact of literacy level on interpretation of symptoms and implementing care instructions by parents. E-health literacy has been introduced by digital sources. E-health literacy of the parents has a relationship with fever and anxiety management skill, demonstrating the requirement to enable parents to understand the quality of online information (Küçük, 2025). This evidence is relevant for Al-Naqrah PHC because parents receive information from social media, relations, websites, and pharmacies before consulting clinicians. Therefore, a structured programme might be considered an accessible source, locally credible, and trusted.

Antipyretic Use and Home Management Practices

Parental fever practices tend to focus on medication, particularly on taking the child's temperature and administering antipyretics such as Paracetamol and Ibuprofen. Use of antipyretics can enhance comfort, but inadequate dosage, unnecessary use and unsafe alternating antipyretics use are concerns. Saudi evidence regarding OTC antipyretic use in the last few years revealed some parents self-medicating their children; and that some parents were not knowledgeable of indications, dosage and risks (Sakr et al., 2022). International literature also suggests that parents may give antipyretics when the child's temperature is just below the threshold, even if the child feels no discomfort, is quite hydrated, acting normally and has no other warning signs. Thus, the goal of fever awareness programmes should be to get parents to focus not on “normalising temperature” but on the child, with a safe use of medication and an understanding of the need for professional assessment (Ng et al., 2023).

Educational Interventions and Awareness Programmes

Most research assessing the effects of fever education reports that a structured approach with parents is effective, but the format differs. A basic educational intervention was effective in increasing parents' knowledge and appropriate management of fevers, as demonstrated by Kelly et al. (2019). In more recent studies, Toksoz and Acikgoz (2024) reported positive effects of video-based distance education on both parents' knowledge and on how they manage fevers, while Nam and Kang (2025) created a case-based simulation programme that enhanced knowledge, lowered parents' anxiety, and increased self-efficacy. The results indicate that the education of fever can be conducted through various approaches such as face-to-face counselling, written material, video, mobile app, and scenario-based learning. Brief, repeated interventions may be particularly accessible in primary care contexts as they can be delivered during vaccination appointments, paediatric appointments, during waiting room education, and by nurses who provide health promotion (Kelly et al., 2019).

Gap in Saudi and Regional Evidence

Saudi studies show that parental fever misconceptions persist, even with good access to healthcare and development of public health. Hussain et al. (2020) suggests that parents in Saudi Arabia still have fever phobia and inconsistent management strategies. The regional evidence, however, is largely cross-sectional and geared towards assessing knowledge, attitudes and practices, not testing and mapping solutions to education. Furthermore, few studies have specifically focused on primary healthcare centres in Ha'il or equivalent communities in the north of Saudi Arabia. This gap is important because local language, culture, roles within the family, decision making of the mother and father, access to digital devices and trust in PHC professionals should be taken into account when designing intervention.

Implications for the Current Scoping Review

The literature overall demonstrates that knowledge, anxiety, health literacy and medication practices and accessibility to reliable advice all influence childhood fever management. There is already some research to support educational interventions although the evidence was varied in design and setting, content and outcomes. A scoping review is thus suitable to establish a picture of the existing knowledge and to identify the components of interventions and gaps relevant to Al-Naqrah PHC. This review can help inform the development of a culturally appropriate awareness program to enhance parental health literacy, mitigate unneeded fear and to increase safe management of fevers at home.

Research Questions

General Aim

The aim of this scoping review is to map and synthesise evidence related to effectiveness of childhood fever awareness programmes for parents and their impact on fever-related knowledge, health literacy, home management practices and confidence. The research is related to practices at Al-Naqrah Primary Health Care Centre in Ha'il, Saudi Arabia. A scoping review guidance suggested by this aim recommends broad mapping questions when the evidence is fragmented across concept, population, context, outcome measurement, and intervention format (JBI, 2025).

3.2 Specific Objectives

1. To identify components of education used in childhood fever awareness programmes for parents, like printed materials, counselling, digital tools, videos, nurse-led instructions, and simulations.
2. To analyse the influence of these programmes on parental health literacy, recognition of danger signs, knowledge of fever thresholds, antipyretic use, and behaviour of healthcare-seeking.
3. To compare delivery modes and settings, interventions implemented by hospitals, primary healthcare, online platforms, or community settings.
4. To determine gaps in evidence that may help in developing culturally-informed awareness programs for parents attending Al-Naqrah PHC.

3.3 Research Questions

Main Question

What evidence exists for parents related to childhood fever awareness programmes, and what is the influence of these programmes on parental fever management?

Sub-Questions

1. What are usually targeted literacy barriers and misconceptions?
2. Which are apparently mostly useful intervention components?
3. What results are measured?
4. In Saudi healthcare, what is the applicable evidence?

The recent studies according to which parental health literacy has a relationship with fever management, justify this question. These studies have highlighted persistent gaps in parental knowledge (Menekşe et al., 2024).

Methodology

Study Design

A scoping review methodology has been adopted in this paper to map evidence related to parental childhood fever awareness programmes and their relationship with knowledge, health literacy, fever management behaviour, and confidence. This design is suitable

because of the heterogeneous evidence base, including educational interventions, cross-sectional surveys, qualitative work, digital health studies, reviews, and clinical educational reports. Joanna Briggs Institution (JBI) methodology has been used to guide this review (JBI, 2025). It recommends scoping review when the purpose of research is to identify types of evidence, clarify concepts, inform programme development, or examine gaps in knowledge. The PRISMA extension has been used for Scoping Reviews to strengthen transparency in information sources, eligibility criteria, synthesis, and charting methods (Tricco et al., 2018).

Review Questions and PCC Framework

Following is the review question:

What evidence exists for parents related to childhood fever awareness programmes, and what is the influence of these programmes on parental fever management?

Caregivers and parents of the children constitute the population of this study. The study will particularly focus those who are responsible for making fever-related decisions at home. Childhood fever awareness is the main Concept, which includes counselling, education, printed materials, e-health or mobile tools, videos, nurse-led instructions, and simulation. Primary health or community settings is the Context, which particularly focuses on evidence transferable to Al-Naqrah PHC. This PCC structure is suitable according to JBI guidance for broad evidence mapping instead of defect simulation (JBI, 2025).

Search Strategy and Sources

Systematic search will be done using PubMed/MEDLINE, CINAHL, Scopus, Web of Science, ScienceDirect and Google Scholar. The search terms will include keywords or subject headings related to: ‘childhood fever’, ‘parents’/ ‘caregivers’, ‘fever phobia’, ‘health literacy’, ‘e-health literacy’, ‘awareness programme’, ‘educational intervention’, ‘antipyretic use’, ‘primary healthcare’, ‘Saudi Arabia’. Boolean operators and truncation will be tailored to the individual databases. Reference lists of relevant reviews and included studies will be screened to locate additional sources. The search will focus on literature published between 2019 and 2026 to reflect current practices in information seeking by parents, digital literacy, and post-pandemic healthcare seeking, as well as seminal older literature about fever in children.

Eligibility Criteria

Studies will be included which focus on parents/caregivers of children, childhood fever knowledge or management, description or evaluation of an awareness or educational component, measurement of outcome(s) related to health literacy, anxiety, self-efficacy, antipyretic use, danger-sign recognition or healthcare-seeking behaviour. The following types of evidence will be considered: quantitative, qualitative, mixed methods, quasi-experimental, randomized, cross-sectional, review, and guideline-based. Studies that are limited to adult fever and/or only hospital treatment of a specific febrile disease without parental education, opinion pieces without methodological description, or non-retrievable full texts will not be included.

Screening, Data Charting, and Synthesis

All the results of the search will be exported to reference-management software, and the duplications will be deleted. Titles and abstracts will be evaluated for eligibility and subsequently full-text articles will be reviewed. A data-charting form will be used to pull the following information: author, year, country, design, population, setting, intervention

type, delivery mode, outcome measures, key findings, relevance to Saudi PHC. Normally scoping reviews map breadth does not pool effects, so results will be synthesized narratively and thematically. Themes should involve misconceptions about fever, fear of fever, decision making around antipyretics, e-health literacy, modes of delivery for education and PHC considerations.

Conceptual Framework

The conceptual framework suggests that the childhood fever awareness programme impacts the outcomes for parents in three linked ways. First, exposure to information enhances knowledge of the following: factors involved in the development of a fever; normal physiology; safe use of antipyretic medications; hydration; comfort measures; and danger signs. Second, better understanding lessens anxiety and fear of the fever as evidence-based decision cues supplant threat-based interpretations. Third, better health literacy improves the capacity of parents to access, evaluate, and implement fever implementation in real-life situations. Recent studies have confirmed these relationships, finding that parental health literacy and e-health literacy are associated with managing a fever and with anxiety and with making health-care decisions (Menekşe et al., 2024; Küçük, 2025). The expected practice outcomes are: safer home care, less unnecessary emergency visits, better communication between clinicians and PHC and more appropriate PHC use (Menekşe et al., 2024).

Table 1: PCC Framework for Scoping Review

PCC Element	Application in this Study
Population	Caregivers or parents of children experiencing fever
Concept	Childhood fever awareness programmes, fever knowledge, health literacy, danger-sign recognition, antipyretic use
Context	Primary healthcare, Saudi-relevant settings, family, community, with emphasis on Al-Naqrah PHC in Ha'il

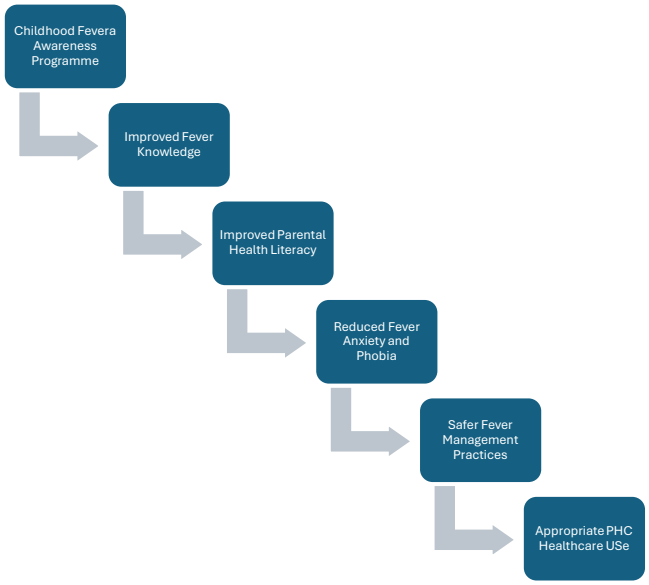

Figure 1: Suggested Framework

Ethical and Quality Considerations

This is a literature-based study, so this does not require participants' consent. Yet, in an ethical way of writing scholarly work, findings should be presented accurately, reporting is transparent, there should be no selective citation, and culture should be taken into account. Studies that were included will have methodological limitations explained to avoid overclaiming effectiveness when there is preliminary evidence. The essentiality of these safeguards is due to the fact that a locally adapted programme should be grounded on positive findings as well as barriers, weak programme designs, inconsistent measures, and contextual factors which will influence the learning of parents in Saudi primary healthcare practice and subsequent local programme evaluation studies.

Analysis

Interpreting Childhood Fever as a Health Literacy Problem

There are indications that childhood fever is not a biomedical sign but a literacy challenge for parents. Parents typically control the fever before seeking a clinic's opinion and the degree of temperature, child appearance, requirement for medication, and danger signs will influence quality of care in the early phase. There is evidence that many parents have knowledge and practices, even with frequent contact with healthcare services, in Saudi Arabia (Hussain et al., 2020). It means clinical access does not guarantee competent management at home. An awareness programme, therefore, needs to be more than just about transferring information at Al-Naqrah PHC and build the capacity of parents to be able to make a judgement about which fever is benign, which fever can be managed with comfort care and which fever requires assessment (Hussain et al., 2020).

Fever Phobia and Risk Perception

One consistent theme in the studies is that fever phobia persists to affect parental decisions. Fever can be a source of worry for parents even if the child is clinically stable, because they might think that it indicates brain damage, convulsions, dehydration, coma or death. This exaggerated risk perception is what gives rise to such repetitive temperature testing, the need to wake children to give their medicine, the mixing of medicines, the demand for antibiotics and the use of urgent care predominantly to alleviate anxiety. There is a persistent concern about fever among parents, as evidenced by recent studies of parents' knowledge about fever, which indicate that a fever phobia does not just go away with general schooling (Çelik & Güzel, 2024; Cengiz & Gündüz, 2025). The design of the programme should, therefore, focus on emotions directly through reassurance, scenarios, danger-sign algorithms and not just on facts (Çelik & Güzel, 2024; Cengiz & Gündüz, 2025).

Knowledge, Medication Practice, and Safety

There is also literature indicating a tendency for parental fever management to be medication-based. When providing comfort for children, paracetamol and ibuprofen are helpful but incorrect dose calculation, dosing too frequently, alternating protocols and unnecessary medication contribute to unwarranted risks. Saudi research exploring OTC use of antipyretics reveals an ongoing lack of knowledge, attitudes and practices regarding the administration of Paracetamol and Ibuprofen among parents (Alwashali et al., 2024). Parenting practices are also shown to be influenced by the number on the thermometer, not by the behaviour, hydration, sleep, breathing, or responsibility of the child, in international evidence. An effective awareness programme, therefore, needs to change the attitude from the use of antipyretics as compulsory fever eliminators to using them as measures to relieve pain and needs to incorporate the following: weight-based

dosage, spacing, contraindications, record keeping, and advice for consultation with the pharmacy (Alwashali et al., 2024).

Health Literacy, E-Health Literacy, and Information Appraisal

Health literacy seems to play a crucial role in the interplay between education and better management of fever disease. Menekşe et al. (2024) identified that parents' health literacy is related to their level of acceptance of advice on fever management, suggesting that more than providing the advice is needed, interpretive skills are required. Part of this is due to digital information, as parents are increasingly using websites, social media, search engines and messaging groups before reaching out to clinicians. Similarly, Küçük (2025) and colleagues found a correlation between the use of e-health literacy and the way parents manage their fever and anxiety, suggesting that parents' capacity to assess online information influences parental care decisions. Al-Naqrah PHC should provide parents with an awareness programme that educates them about the sources that are safe to use online, how to identify misinformation and when online advice should be replaced by clinical advice (Menekşe et al., 2024).

Effectiveness of Educational Interventions

Educational interventions suggest that structured parental education can be useful to enhance knowledge and confidence and safe practices. Short, repeated digital education has potential to be feasible for today's busy families, as it has been demonstrated to enhance parents' knowledge about how to manage a fever and decrease the burden of caregiving (Toksoz & Acikgoz, 2024). Because case-based simulation places parents in decisional situations that resemble reality, other skills, such as fever knowledge and anxiety and self-efficacy have also been improved (Nam & Kang, 2025). The results lend weight to the blended PHC model of brief nurse-led counselling, simple decision tools, illustrated leaflets, and short Arabic videos that are provided during PHC visits, such as vaccination appointments, child health checks or paediatric consultations (Nam & Kang, 2025; Toksoz & Acikgoz, 2024).

Relevance to Al-Naqrah PHC

Global evidence can be applied to Al-Naqrah PHC if the evidence is culturally and organisationally appropriate. Fever management may be dependent on extended family advice, community norms, pharmacists and social media for advice and guidance, and mothers may have day-to-day responsibility for fever management. As such, language of intervention, examples and visuals should be culturally familiar and simplified in Arabic. Repeated interactions can help PHC staff repeat messages, correct unsafe behaviors and encourage the appropriate use of consultation. Care-seeking should not be discouraged by the programme; rather, the parents should be able to differentiate between manageable fever episodes and urgent danger signs. This could decrease the number of unnecessary visits and ensure children receive the necessary evaluation in a timely manner.

Critical Interpretation and Synthesis

The evidence overall is supportive of the implementation of childhood fever awareness programmes, but at the same time shows limitations. They are often cross sectional based, are self-reported, have different outcome measures, and less frequently, evaluate long-term behavioral change. Intervention studies typically show knowledge improvement in the short term and less evidence of long-term health literacy, reduced attendance in the emergency department and reduced medication risk. Thus, the scoping review does not warrant a blanket conclusion of the effectiveness of all awareness programmes. The study

suggests an informed conclusion: A combination of knowledge, emotional reassurance, practical decision tools, and safe medication guidance is likely to enhance parental health literacy with structured, theory-informed and culturally adapted programmes. The most powerful implication is the development of a locally appropriate programme and its testing with pre and post health literacy, fever knowledge and self-efficacy and practice indicators for Al-Naqrah PHC.

Table 2: Summary of Key Literature Themes

Theme	Main Evidence Pattern	Relevance to Al-Naqrah PHC
Fever Misconceptions	Misunderstanding fever thresholds and complications by parents	Basic fever beliefs must be corrected by the programme
Antipyretic Safety	Alternating medicines and incorrect dosing are common.	Weight-based dosing must be taught at PHC
Fever Phobia	Anxiety results in overtreatment and urgent care-seeking	Education should consist of red flags and reassurances
Digital Information Use	Parents depend on social media and websites	Parents should achieve guidance from PHC towards reliable sources
Health Literacy	Interpretation and decision-making affected by literacy	Simple Arabic tools to be used in programme
Educational Interventions	Scenarios, counselling, and videos improve knowledge	Blended PHC programme might be most appropriate

Findings and Results

6.1 Overview of Mapped Evidence

The mapped literature highlights the influence of three recurring result clusters on parental childhood fever management, including variable health literacy, anxiety-driven practices, and knowledge deficits. The findings from previous studies suggest that fever is mostly misinterpreted by the parents as an independent danger. They do not consider it as a symptom needing contextual evaluation. Usual gaps include fear of neurological harm, fever thresholds, overdependence on antipyretics, and uncertainty about danger signs. Alwashali et al. (2024) highlighted that parents have inadequate knowledge regarding the use of ibuprofen and paracetamol, which confirms the significance of medication-safety education.

Findings on Awareness Programmes

Favourable short-term outcomes can be achieved from educational interventions. Distance education through video improved fever-management knowledge in parents and reduced burden on caregivers. It means that the busy families can opt for digital education. Case-based simulation programmes can also be useful because they can enable the parents to use their fever-related knowledge in actual situations. This will improve their self-efficacy and confidence. These results show that Al-Naqrah's awareness programme should not depend on lectures alone. The programme should also include visual dosing guidance, Arabic explanations, clear instructions on seeking medical care, and symptom scenarios (Toksoz & Acikgoz, 2024).

Findings on Health Literacy Outcomes

The overarching discovery is that health literacy can be a means of change and a consequence. The higher the level of health literacy among parents, the more likely they are to be able to understand the information on fever; use medicines safely; and determine whether home care or clinical consultation is needed. The importance of e-health literacy is growing due to the high frequency parents use the internet, search engines and social media before going to the clinic. The findings indicated that there is a relationship between e-health literacy and anxiety, and the ability to manage fever, so it is recommended that, when creating an awareness project about fever, an evaluation of digital information should be included (Küçük, 2025).

Evidence Gaps and Local Relevance

The evidence that is reviewed indicates that structured parental fever education is supported, with some gaps in evidence. Studies which are conducted in primary healthcare settings in Saudi Arabia are limited in number, and a limited number of studies measures sustained behavioural change, as well as different outcomes measures across studies. Hence the findings should be seen as indicative of successful elements of the programme, and not as a guarantee of lasting effectiveness. Based on the results of this study, Al-Naqrah PHC should consider developing a culturally adapted programme along with assessing parental knowledge, health literacy, confidence, medication safety and healthcare-seeking behaviour before and after programme implementation.

Conclusion

Findings from this scoping review confirm a clinically common but socially complex nature of childhood fever. The findings suggest that fever is still interpreted by many parents as a direct threat instead of a regulated physiological response. It is necessary to judge this response along with hydration, behaviour, responsiveness, and breathing of the child. Fear of fever, lack of health literacy, unsafe ways to treat fever or reliance on information from informal or digital sources may contribute to fears, unnecessary health care visits or how to manage fever at home. The review further reveals that structured awareness programmes have the potential to enhance parents' knowledge, confidence, medication safety, and decision-making, especially when they involve hands-on learning, are culturally relatable, are repeated, and are provided by trusted healthcare providers. The results have implications for the implementation of a childhood fever awareness programme for safe home care and informed use of services (IHU) developed and adapted locally in Al-Naqrah PHC, Ha'il.

Fever education should not be an isolated component of child health services provided by primary healthcare staff but should be delivered as an integral part. Vaccination visits, paediatric consultations, waiting rooms and digital communication tools are good opportunities for nurses, physicians and health educators to communicate the same messages consistently. Fever definition, use of thermometers, comfort-based care, weight-based antipyretic dosing, hydration, red flags and PHC/emergency attendance at the right time should feature in the programme content.

The findings recommend implementing parental fever literacy at policy level as part of the health-promoting activities in primary healthcare in Saudi Arabia. Consistent advice across families and providers might be reduced with the use of standardised Arabic resources, simple algorithms and digital resources. Future studies should assess the proposed Al-Naqrah PHC programme for changes in health literacy, knowledge of fever,

self-efficacy, medicine use, anxiety and health-seeking behaviour pre and post implementation. Long-term follow-up is required to assess whether educational outcomes are associated with long-term safer home management and using the healthcare more appropriately within Saudi family-centred child healthcare services.

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The Impact of Emotional Intelligence and Resilience on Nursing Work Efficiency: Evidence from The Qassim Health Cluster

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Abstract

Emotional intelligence plays an important role in nursing practice and influences how nurses interact with patients, families, and colleagues, thereby determining the quality of healthcare services. High work pressure can reduce work efficiency; therefore, resilience and emotional intelligence are considered essential psychological competencies. Nurses with high emotional intelligence tend to demonstrate more effective communication skills, stronger empathy, and the ability to manage conflicts constructively. The purpose of this study is to analyze the influence of emotional intelligence and nursing resilience on nurses' work efficiency, with work engagement as a mediating variable in the Qassim Health Cluster, Saudi Arabia. This study employed a quantitative approach using a cross-sectional survey design involving nursing staff working in various hospital service units. Data were collected through a structured questionnaire measuring emotional intelligence, nursing resilience, work engagement, and nursing work efficiency using a Likert scale. Data analysis was conducted using Structural Equation Modeling (SEM) to examine the relationships among variables and the mediating role of work engagement. The findings indicate that strengthening the psychological capacity of nursing staff can enhance work engagement and overall healthcare service efficiency. This study provides important implications for hospital management in formulating human resource development policies by assessing and improving emotional intelligence and psychological resilience among healthcare workers to enhance the quality of healthcare services and organizational performance, particularly in nursing practice.

Keywords: Emotional Intelligence, Healthcare Workforce Performance, Nursing Work Efficiency, Nursing Resilience, Work Engagement

Introduction

Modern healthcare systems increasingly depend on the competence and efficiency of healthcare professionals, particularly nurses who serve as the frontline providers of patient-centred care. Nurses are responsible not only for delivering direct clinical services but also for coordinating multidisciplinary care, monitoring patient conditions, and maintaining communication with patients' families and healthcare teams. Consequently, nursing performance significantly influences healthcare quality, patient safety, organizational effectiveness, and overall hospital sustainability (Cummings et al., 2021; Zhang et al., 2023). As healthcare demands continue to rise globally due to demographic transitions, chronic disease prevalence, and technological advancements, nurses are required to work in increasingly complex and demanding clinical environments.

Review of Related Literature

The growing complexity of healthcare delivery has intensified physical and psychological pressures experienced by nurses. Heavy workloads, emotional exhaustion, long working hours, and rapid decision-making requirements frequently contribute to occupational stress and declining work performance. Previous studies have reported that prolonged exposure to stressful clinical conditions may reduce productivity, increase burnout risk, and negatively affect healthcare quality and employee well-being (Dyrbye et al., 2020; West et al., 2020). Nursing professionals are particularly vulnerable because they continuously interact with patients experiencing pain, trauma, and critical illnesses, which creates substantial emotional strain and may weaken motivation and work efficiency over time (Kaushik et al., 2021).

Recent literature emphasizes the importance of psychological resources in maintaining healthcare professionals' performance under stressful conditions. Emotional intelligence has emerged as a significant factor because it enables individuals to recognize, regulate, and manage emotions effectively while maintaining positive interpersonal relationships in the workplace. Nurses with strong emotional intelligence are generally better at communication, empathy, emotional regulation, and conflict management, all of which contribute to improved work engagement and professional performance (Kim et al., 2022; Al-Hamdan et al., 2021). In addition, psychological resilience plays a crucial role in helping nurses adapt positively to workplace adversity and maintain psychological stability in challenging clinical situations. Resilient nurses tend to demonstrate stronger coping abilities, lower emotional exhaustion, and better work outcomes despite high occupational demands (Godoy et al., 2022; Lee et al., 2024).

Another important determinant of healthcare performance is work engagement, which reflects employees' energy, dedication, and absorption in their work roles. According to the Job Demands–Resources (JD-R) Theory, personal psychological resources such as emotional intelligence and resilience can strengthen employee engagement and ultimately improve work performance and organizational productivity (Bakker & Demerouti, 2020). However, empirical evidence examining the mediating role of work engagement in the relationship between emotional intelligence, resilience, and nurses' work efficiency remains limited, particularly within Middle Eastern healthcare settings, including Saudi Arabia. Therefore, this study aims to analyze the effects of emotional intelligence and psychological resilience on nurses' work efficiency with work engagement serving as a mediating variable among nurses in the Qassim Health Cluster, Saudi Arabia.

Methodology

Research Design

This study employed a quantitative approach using a cross-sectional survey design to analyze the relationships among emotional intelligence, nursing resilience, work engagement, and nurses' work efficiency. The quantitative approach was selected because it enables researchers to empirically examine relationships among variables through measurable and objective statistical analysis.

A cross-sectional design was used because data were collected from respondents at a single point in time representing the study population. This design allows researchers to describe the conditions of the research variables and identify relationships among variables within the context of healthcare organizations during the study period. The

study aimed to examine the effects of emotional intelligence and nursing resilience on nurses' work efficiency, with work engagement serving as a mediating variable.

Research Setting and Population

This study was conducted among nurses working in various hospitals within the Qassim Health Cluster, Saudi Arabia. The health cluster is part of the healthcare system responsible for providing healthcare services to communities in the Qassim region. The population of this study consisted of all nurses working in hospitals within the Qassim Health Cluster, including nurses assigned to various healthcare service units such as inpatient units, emergency departments, intensive care units, outpatient clinics, and other specialized units. Nurses working in these healthcare units have different job characteristics, which may lead to variations in emotional intelligence, psychological resilience, work engagement, and work efficiency levels.

The sampling technique used in this study was stratified random sampling. This method was chosen to ensure that the research sample adequately represented the various hospital service units included in the study population. In this technique, the nursing population was first grouped based on work units or healthcare departments. Respondents were then randomly selected from each group so that every service unit had an equal opportunity to be represented in the sample. The use of stratified random sampling aimed to improve sample representativeness and reduce potential bias in respondent selection. The total sample consisted of 262 nurses working in various hospital service units within the Qassim Health Cluster. This sample size was considered adequate for Structural Equation Modeling (SEM) analysis because it met the recommended minimum sample size for SEM studies, which generally ranges from 200 to 400 respondents.

Research Instrument

Data collection in this study was conducted using a structured questionnaire developed based on research instruments that had been widely used in previous studies. The questionnaire consisted of measures related to emotional intelligence, nursing resilience, work engagement, and nurses' work efficiency. All questionnaire items were measured using a five-point Likert scale.

Data Collection

Research data were collected through the distribution of questionnaires to nurses participating as study respondents. The questionnaires were distributed both directly and through online platforms to facilitate respondents in completing the survey. Before the data collection process, the researcher provided explanations regarding the objectives of the study and assured respondents that all information provided would remain confidential. Participation in this study was entirely voluntary.
Data analysis was performed using the Structural Equation Modeling (SEM) method with the assistance of SmartPLS software,

Analysis

Structural Model Analysis Results

Data analysis was performed using Structural Equation Modeling–Partial Least Squares (SEM-PLS) with the assistance of SmartPLS software to evaluate the structural relationships among emotional intelligence, nursing resilience, work engagement, and nurses' work efficiency. SEM-PLS was selected because it is considered appropriate for examining complex predictive models involving multiple latent variables and mediation

effects simultaneously. In addition, this analytical approach is suitable for behavioral and organizational research that emphasizes prediction and theory development. Prior to testing the structural model, the measurement model was evaluated to ensure the reliability and validity of all constructs. The findings demonstrated that all constructs achieved acceptable levels of reliability, as indicated by Cronbach's alpha and composite reliability values above the recommended threshold of 0.70. Furthermore, convergent validity was confirmed through Average Variance Extracted (AVE) values exceeding 0.50 for all constructs, indicating that the indicators adequately represented their respective latent variables. Discriminant validity was also established using the Fornell–Larcker criterion and Heterotrait–Monotrait Ratio (HTMT), confirming that each construct was conceptually distinct from the others.

The structural model assessment revealed that the proposed research model had substantial explanatory power. The R-square (R^2) value for work engagement was 0.58, indicating that emotional intelligence and nursing resilience jointly explained 58% of the variance in nurses' work engagement. This result suggests that psychological resources play an important role in enhancing nurses' psychological involvement and motivation at work. Meanwhile, the R-square value for nurses' work efficiency was 0.63, indicating that emotional intelligence, resilience, and work engagement collectively explained 63% of the variance in work efficiency. These findings demonstrate that the proposed model possesses strong predictive capability in explaining nurses' performance outcomes within healthcare organizations.

Hypothesis testing was conducted using the bootstrapping procedure to examine the significance of direct and indirect relationships among variables. The results showed that all hypothesized relationships produced t-statistics greater than 1.96 and p-values lower than 0.05, indicating statistically significant effects. Emotional intelligence and resilience were found to positively influence work engagement and nurses' work efficiency. In addition, work engagement significantly influenced work efficiency and partially mediated the relationships between emotional intelligence, resilience, and work efficiency. These findings support the Job Demands–Resources (JD-R) Theory and Conservation of Resources (COR) Theory, emphasizing the importance of psychological resources in improving nurses' engagement and performance in demanding healthcare environments.

Findings and Discussion

The Effect of Emotional Intelligence on Work Engagement

The results of this study demonstrated that emotional intelligence had a positive and statistically significant effect on nurses' work engagement. This finding suggests that nurses who possess stronger abilities to recognize, understand, regulate, and express emotions effectively are more likely to exhibit higher levels of psychological attachment to their work. In the nursing profession, emotional intelligence is particularly important because nurses are continuously exposed to emotionally demanding situations involving patients, families, and multidisciplinary healthcare teams. The ability to manage emotions appropriately enables nurses to remain motivated, focused, and psychologically connected to their professional responsibilities despite challenging working conditions.

The findings are consistent with previous research indicating that emotional intelligence contributes significantly to employees' motivation, communication quality, and interpersonal relationships within healthcare organizations (Al-Hamdan et al., 2021). Nurses with high emotional intelligence are generally better equipped to manage

workplace conflicts, maintain positive social interactions, and provide empathetic patient care, all of which strengthen their engagement at work. Similarly, Kim et al. (2022) reported that emotionally intelligent nurses tend to demonstrate stronger organizational commitment, greater professional dedication, and higher resilience in dealing with occupational stressors.

From a theoretical perspective, this finding supports the Job Demands–Resources (JD-R) Theory, which emphasizes that personal resources such as emotional intelligence can enhance motivational processes and strengthen work engagement. Emotional intelligence functions as a valuable psychological resource that helps nurses manage emotional exhaustion and maintain enthusiasm in their daily tasks. Therefore, emotional intelligence not only influences interpersonal effectiveness but also contributes to sustaining positive work attitudes and improving overall nursing performance. Based on these findings, emotional intelligence can be considered a critical psychological factor that enhances nurses' work engagement and supports the sustainability of healthcare service quality within hospital organizations.

The Effect of Resilience on Work Engagement

The study results also showed that nursing resilience had a positive and significant effect on nurses' work engagement. Nurses who possess the ability to adapt to workplace pressure tend to demonstrate higher levels of energy and dedication in carrying out their professional responsibilities.

This finding is consistent with previous research indicating that psychological resilience helps healthcare professionals cope with occupational stress and improve their work engagement within organizations (Gotterson et al., 2021). Other studies have also shown that healthcare workers with high levels of resilience tend to experience better psychological well-being and are more capable of maintaining work motivation (Godoy et al., 2022).

These findings suggest that resilience is an important psychological resource in supporting nurses' work engagement.

The Effect of Emotional Intelligence on Nurses' Work Efficiency

The results demonstrated that emotional intelligence had a positive effect on nurses' work efficiency. Nurses with high levels of emotional intelligence tend to manage emotional pressure in the workplace more effectively, thereby improving work productivity. This finding is in line with previous studies showing that emotional intelligence plays an important role in improving healthcare professionals' performance and the quality of patient care (Zhang et al., 2023). Additionally, other studies have found that emotional intelligence can enhance interpersonal communication skills and teamwork effectiveness within healthcare organizations (Ahmed et al., 2024).

Therefore, emotional intelligence can be considered an important competency that contributes to improving nurses' work efficiency.

The Effect of Resilience on Nurses' Work Efficiency

The study findings also revealed that resilience had a positive and significant effect on nurses' work efficiency. Nurses with high resilience levels tend to be more capable of coping with workplace pressure while maintaining the quality of healthcare services provided to patients.

This finding is consistent with previous studies indicating that psychological resilience plays a significant role in improving healthcare professionals' performance and reducing the risk of work-related fatigue (Htay & Whitehead, 2021). Furthermore, other studies have demonstrated that healthcare workers with higher resilience levels tend to exhibit better work productivity (Lee et al., 2024). These findings indicate that psychological resilience can help nurses maintain work efficiency in highly demanding work environments.

The Mediating Role of Work Engagement

The mediation analysis results showed that work engagement mediated the relationships between emotional intelligence and resilience with nurses' work efficiency.
This finding indicates that emotional intelligence and resilience not only directly influence work efficiency but also improve work efficiency through increased work engagement among nurses.

These results support the Job Demands–Resources (JD-R) Theory, which suggests that psychological resources such as emotional intelligence and resilience can enhance work engagement, ultimately leading to improved individual performance (Bakker & Demerouti, 2020). Other studies have also shown that work engagement is an important factor linking psychological resources with healthcare professionals' performance (Martinez et al., 2023).

Therefore, improving nurses' emotional intelligence and psychological resilience may serve as an effective strategy for enhancing work engagement and overall healthcare service efficiency.

Research Limitations

- This study has several limitations that should be considered when interpreting the findings. First, the study used a cross-sectional design; therefore, the relationships identified among variables are associative and cannot fully explain causal relationships.
- The study was conducted only among nurses working in hospitals within the Qassim Health Cluster. Consequently, the generalizability of the findings to other healthcare organizational settings should be interpreted with caution.
- The data were collected using self-report questionnaires, which may increase the possibility of respondent perception bias in answering questionnaire items.

Recommendations for Future Research

Based on the limitations of this study, several recommendations for future research are proposed:

- Future studies are recommended to use longitudinal designs to examine causal relationships among emotional intelligence, resilience, work engagement, and nurses' work efficiency more comprehensively.
- Future research may expand the study scope by involving healthcare professionals from different hospitals or healthcare systems across various regions to improve the generalizability of findings.
- Further studies may also incorporate additional variables that potentially influence healthcare workers' efficiency, such as transformational leadership, organizational support, organizational culture, and employee well-being.

- Future research may combine quantitative and qualitative approaches (mixed methods) to gain a more comprehensive understanding of factors influencing healthcare professionals' performance.

Policy Implications

The findings of this study provide important implications for human resource management in the healthcare sector, particularly in nursing workforce development. Hospital management should consider the development of healthcare workers' psychological competencies as part of organizational performance improvement strategies.

Training programs focusing on emotional intelligence development may help nurses improve interpersonal communication skills, empathy toward patients, and conflict management abilities in the workplace. In addition, programs aimed at strengthening psychological resilience are essential to help nurses cope with high levels of work-related stress. Healthcare organizations also need to create work environments that support employee engagement through policies promoting psychological well-being, organizational support, and professional development for healthcare workers. Therefore, improving emotional intelligence, psychological resilience, and work engagement among nurses can become an effective strategy for enhancing healthcare service efficiency and overall organizational performance.

Conclusion

This study aimed to analyze the effects of emotional intelligence and nursing resilience on nurses' work efficiency, with work engagement serving as a mediating variable among nurses in the Qassim Health Cluster, Saudi Arabia. The findings revealed that emotional intelligence and resilience had positive and significant effects on nurses' work engagement. This indicates that nurses who possess the ability to understand and manage emotions, as well as strong psychological resilience, tend to demonstrate higher levels of work engagement in carrying out their professional responsibilities. In addition, the study found that emotional intelligence and resilience positively influenced nurses' work efficiency. Nurses with strong emotional intelligence were better able to manage emotional pressure in the workplace, thereby improving productivity and the quality of healthcare services. Meanwhile, psychological resilience helped nurses cope with workplace stress and maintain professional performance in challenging work situations.

The mediation analysis further demonstrated that work engagement played an important role in mediating the relationship between emotional intelligence and resilience with nurses' work efficiency. These findings indicate that improvements in emotional intelligence and psychological resilience not only directly enhance work efficiency but also indirectly improve efficiency through increased work engagement among nurses.

Overall, this study confirms that psychological factors such as emotional intelligence and resilience are important resources that can enhance nurses' work engagement and work efficiency within healthcare organizations.

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Identification of Active Compounds in Chinese Herbal Medicines

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Abstract

The process of incorporating Chinese Herbal Medicines (CHM) into modern healthcare has been hindered despite its effectiveness as a therapeutic option. Following this, the primary research question of the study intends to critically evaluate the pharmacological effect of phytochemical profiles of CHM such as glycosides, alkaloids and flavonoids assessing its anti-inflammatory, antioxidant, and antidiabetic impacts respectively. The systematic review analysis research has included a total of 25 peer reviewed articles about the anti-inflammatory impact of glycosides, the antioxidant impact of alkaloids and the antidiabetic impact of flavonoids consecutively. Additionally, the researcher used systematic review analysis research for collecting relevant data. Study analysis techniques such as Chromatography output was the main method. This technique separates CHM complex Botanical Mixtures into individual CHM compounds meant to specific bioactive pharmacological aspects. The researcher looked at each chemical to see whether ones had bioactivity. Integrated processes make sure that all the batches are the same. The researcher then looked at how these chemicals interacted with biological processes in cells and tissues. The findings of the study showed alkaloids eliminate harmful free radicals. Similarly, glycosides reduce inflammation by affecting cell signalling pathways along with flavonoids can be influenced into specific biologically active compounds. The conclusion of the study highlighted the link between traditional knowledge and modern science can work together to improve patient care by identifying the anti-inflammatory influence of glycosides, the antidiabetic aspect of flavonoids and the antioxidant properties of alkaloids.

Keywords: Alkaloids, Chinese Herbal Medicine, Flavonoids, Glycosides, Phytochemical Profiling

Introduction

CHM has a large therapeutic repertory; nevertheless, the clinical integration of CHM into contemporary healthcare is slow due to a lack of scientific knowledge of the numerous components that make up CHM. Because of this suggestion, a comprehensive investigation of the phytochemical and pharmacological properties of herbs that are frequently employed in CHM is described (Wang et al., 2026). The purpose is to locate active compounds and establish connections between them and therapeutic pathways in order to enable empirical application. People have been using plant-based medicines for thousands of years. Today, CHM herbs are made up of hundreds of different chemicals, such as alkaloids, flavonoids, terpenoids, and glycosides. CHMs work on a "multi-component, multi-target" theory,

which is different from phytochemical herbal drugs, which usually only have one active ingredient (Williamson et al., 2009). Even though they are popular, there are still problems with quality control, differences between batches, and possible interactions between herbs and drugs. High-Performance Liquid Chromatography (HPLC), Mass Spectrometry (MS), and Network Pharmacology are some of the new analytical technologies that can help us figure out these complicated mixtures" (Sivaji et al., 2026). To make sure that "CHM products are safe for patients, work as well as possible, and get regulatory approval around the world, it is important to know the specific active compounds and how they work in the body".

Review of Related Literature

CHM is a medical clinic that originated in China. It is a holistic health care approach that incorporates the fact that it has a clinical history that spans over two thousand years (Angeles Flores et al., 2026). It does this by using herbal mixtures that include a wide range of components in order to accomplish this. The assimilation of contemporary Chinese medicine into contemporary evidence-based medicine has proven to be challenging owing to the intricate phytochemical composition of traditional Chinese treatment in addition to the lack of information of the techniques that are involved in its practice (Burhan et al., 2026). Within the context of the paradigm shift, the replacement of empirical application with a scientific framework which happens reductionist while nevertheless remaining complete is required. Research on phytochemicals, the establishment of a profile for pharmacological validation, and the development of new techniques for locating active substances in herbs that are used in CHM are all included in the scope of this project, which spans from the year 2020 to the particular year 2026 (Al-Farsi et al., 2026). This brings together both conventional knowledge and contemporary discoveries into a single body of information. Early studies relied heavily on High-Performance Liquid Chromatography (HPLC) coupled with UV detection, which often failed to resolve co-eluting peaks in complex matrices or identify trace bioactive constituents. Existing literature highlights significant progress in the isolation of compounds from major CHM herbs (Li et al., 2026). Gan-Cao, or liquorice, is a popular Chinese herbal medicine derived from the dried roots and rhizomes of Glycyrrhizin uralensis, G. glabra, and G. inflata. The main bioactive constituents of liquorice are triterpene sapiens and various types of flavonoids.

The research periphery of these compounds may vary in different CHM sample batches and thus affect the therapeutic effects. The contents of these compounds may vary in different liquorice batches and thus affect the therapeutic effects. For the purpose of quality control of liquorice, it is necessary to conduct an analysis of saponins and flavonoids that is at the same time accurate and sensitive (Anderson & Krathwohl, 2001). This ensures that the liquorice is both effective and safer than it would otherwise be. In this review, researchers will discuss the changes that have taken place in the phytochemical analysis of liquorice related preparations. Newly established methods are summarized, including spectroscopy, thin-layer chromatography, gas chromatography, high-performance liquid chromatography (HPLC), liquid chromatography/mass spectrometry (LC/MS), capillary electrophoresis, (HSCCC), electrochemistry, and immunoassay (Sharma et al., 2026). For example, Panax ginseng has been investigated a lot for ginsenosides, while Artemisia annua is well-known for artemisinin. Phytochemical Analysis such as prior research has used chromatographic methods to characterise phytochemical ingredients (Joshi et al., 2026).

A lot of research, on the other hand, looks at specific herbs instead than formulas, and the data is typically scattered among several databases. Pharmacological Characteristics such as past research investigation's, show that several CHMs have anti-inflammatory, antioxidant, and antidiabetic effects (Cong et al., 2026). However, the specific pathways (e.g., particular protein targets or gene expressions) are often surmised rather than empirically validated. According to the findings of the past researcher's inquiry, that examining how the scientific analysis of plant-derived compounds in CHM has evolved from empirical observation to advanced analytical techniques. "Past research investigation-journey of research reflects a deepening integration of ancient China's Herbal knowledge with modern Medicine technology, enabling more precise identification and characterization of bioactive constituents along with exploring "how this evolution enhances both the validation of traditional practices" and "the development of evidence-based herbal therapies" (Kiran et al., 2026). This research, bridging the gap between time-honoured herbal practices and contemporary pharmacological insights by systematically evaluating the bioactive constituents of key traditional CHM herbs has evolved significantly from single-marker quantification to comprehensive metabolomic fingerprinting (Guo et al., 2025).

LC/MS provides characteristic fragmentations for the rapid structural identification of licorice saponins and flavonoids. The combination of HPLC and LC/MS is currently the most powerful technique for the quality control of licorice (Jiang et al., 2026). For example, Panax Ginseng has been investigated a lot for ginsenosides, while Artemisia annua is well-known for artemisinin. Phytochemical Analysis in a way Prior research has used chromatographic methods to characterise phytochemical ingredients. A lot of research, on the other hand, looks at specific herbs instead than formulas, and the data is typically scattered among several databases. Pharmacological characteristics studies; show that several CHMs have anti-inflammatory, antioxidant, and antidiabetic effects. However, the specific pathways (e.g., particular protein targets or gene expressions) are often surmised rather than empirically validated (Xing et al., 2026).

Objectives

To identify the active compounds in CHM through evaluating its phytochemical profiles.

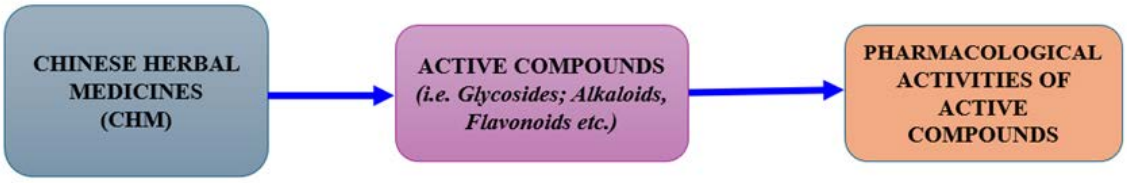
Methodology

There is little understanding of the phytochemical compositions, pharmacological effects, and principal bioactive constituents of traditional Chinese medicine (TCM) herbs, despite their use in clinical environments and considerable popularity. "This research aims to connect traditional herbal practices with modern pharmacological knowledge by thoroughly studying the bioactive components of important traditional remedies. This diversity makes it hard to standardise TCM in modern medicine throughout the world, which is necessary for safe integration and scientific confirmation." According to researcher's inquiry, CHM cannot improve the efficacy of treatments, quality control, or the creation of TCM pharmaceuticals since there are not enough systematic and comparative studies. "This lack of thorough assessment makes it hard to see how TCM may be useful in contemporary medicine". Therefore, more study is necessary to develop dependable approaches that may reconcile old practices with modern scientific standards. In vitro studies designed to evaluate pharmacological activity should use cell-based assays to determine the existence of anti-inflammatory effects (e.g., NO inhibition in macrophages), antioxidant properties (such as DPPH/ABTS radical scavenging), and other potentially significant bioactivities".

Research Design and Procedure

A systematic review and lab-based design was used. The study collected data from 25 peer-reviewed articles published 2018 June up to 2025 July about the anti-inflammatory impact of Glycosides, the antioxidant impact of Alkaloids, and the antidiabetic impact of Flavonoids. CHM use is widespread clinical adoption lags due to lack of compound-level evidence. Traditional whole-herb use conflicts with modern drug regulation that requires single-compound data. “This review focuses on three phytochemical classes with the most published evidence such as glycosides, alkaloids, flavonoids. The objective of this research is to evaluate published studies that used chemical separation to confirm which compound causes which effect. In parallel, 12 CHM raw materials were purchased from certified suppliers and analysed in the lab”.

Operational Framework



Subjects Data Sources

A systematic literature search was conducted across three electronic databases: PubMed, Scopus, and China National Knowledge Infrastructure (CNKI). The search timeframe covered all records available 2018 June up to 2025 July. “The following keyword combinations were applied using Boolean operators such as (a) Glycoside-inflammatory search as “Chinese Herbal Medicines with glycoside” and “inflammation”. Similarly (b) “Alkaloid-antioxidant search performed as “Chinese Herbal Medicines with alkaloid” and “antioxidant” along with (c) Flavonoid-antidiabetic search and analysis “Chinese Herbal Medicines with flavonoid” and “antidiabetic”. A systematic review was conducted following PRISMA 2020 guidelines for transparency and reproducibility.”

Instrumentation and Data Analysis

“Study Selection along with Data Collected from the combined searches”, 25 articles were identified after removing duplicates and applying inclusion/exclusion criteria (e.g., original research, in vivo/in vitro models, full-text availability). Data extracted from these 25 articles included compound identities, bioassay results, and mechanistic pathways relevant to inflammation, oxidative stress, and glycaemic control. A total of 12 dried CHM samples were obtained for laboratory validation as the research maintained procedural step of Herbal Sampling. The collection included, 1st) Glycyrrhiza uralensis(Common name as Licorice); 2nd) Scutellaria baicalensis (Commonly known as Baikal Skullcap); 3rd) Coptis chinensis (Chinese Goldthread); 4th) Panax ginseng(Ginseng); 5th) Rheum palmatum(Rhubarb); 6th) Ginkgo biloba(Ginkgo); 7th) Stevia rebaudiana (Stevia); 8th) Epimedium brevicornu (Horny Goat Weed); 9th) Morus alba (White Mulberry); 10th) Salvia miltiorrhiza (Red Sage else Danshen); 11th) Aloe vera (Common Name as Aloe); last 12th sample as Trigonella foenum-graecum (also known as Fenugreek). Samples were authenticated, pulverized, and stored under desiccated, dark conditions prior to extraction. Research

Sample Preparation along with Extraction performed as each sample dried CHM sample (5 g) was subjected to ultrasonic-assisted extraction using specify solvent, e.g., 70% ethanol or methanol (50 mL) for 30 minutes at 40°C. Extracts were filtered through 0.22 μm PTFE membranes before high-performance liquid chromatography (HPLC) analysis. Analysis of glycosides, alkaloids, and flavonoids in the 12 CHM samples were performed using an Agilent 1260 HPLC system equipped with a diode-array detector (DAD). Agilent Zorbax Eclipse Plus C18 (4.6 × 250 mm, 5 μm particle size) else as specified by guideline. Next research also performed Gradient elution of (A) 0.1% formic acid in water and (B) acetonitrile as per necessity (i.e. Mobile phase). Experimental Flow rate maintained as 1.0 mL/min.along with Injection volume as 10 μL. Column temperature maintained 30°C as much as instrument settings. Research observation based on "Detection wavelengths" set as a) 254 nm (for alkaloids else glycosides),b) 280 nm (for flavonoids), c) and 320 nm (for phenolic acids), with full spectral scanning from 200–400 nm."

Table 1: 12 Dried Chinese Herbal Medicine (CHM) Samples

SL. No	CHM Sample (Latin name)	Common Name	Primary Active Class	Key Molecule(s)	Reported Bioactivity (linked keywords e.g. (a) "Chinese Herbal Medicines + Glycoside" "inflammation" " Chinese Herbal Medicines + Alkaloid" "antioxidant"; "Chinese Herbal Medicines + Flavonoid" ;"Antidiabetic")
1	*Glycyrrhiza uralensis*	Licorice	Glycosides / Triterpenoid saponins	Glycyrrhizin (glycoside), liquiritin (flavonoid glycoside)	Anti-inflammatory (glycoside), antioxidant
2	*Scutellaria baicalensis*	Baikal Skullcap	Flavonoids / Flavone glycosides	Baicalin (flavonoid glycoside), wogonoside, baicalein	Anti-inflammatory, antioxidant, antidiabetic (flavonoid)
3	*Coptis chinensis*	Chinese Goldthread	Alkaloids	Berberine (alkaloid), coptisine, palmatine	Antidiabetic, anti-inflammatory, antioxidant (alkaloid)

4	*Panax ginseng*	Ginseng	Glycosides (Ginsenosides)	Ginsenoside Rb1, Rg1, Re (all glycosides)	Antidiabetic, anti-inflammatory, antioxidant
5	*Rheum palmatum*	Rhubarb	Glycosides + Anthraquinones	Emodin (glycoside form), rhein, sennoside A	Anti-inflammatory, antioxidant
6	*Ginkgo biloba*	Ginkgo	Flavonoid glycosides	Quercetin-3-O-glucoside, kaempferol glycosides, isorhamnetin	Antioxidant, antidiabetic (flavonoid)
7	*Stevia rebaudiana*	Stevia	Glycosides (Steviol glycosides)	Stevioside, rebaudioside A	Antidiabetic (glycoside), anti-inflammatory
8	*Epimedium brevicornu*	Horny Goat Weed	Flavonoid glycosides	Icariin (flavonoid glycoside)	Antidiabetic, anti-inflammatory
9	*Morus alba*	White Mulberry	Alkaloids + Flavonoids	1-Deoxynojirimycin (alkaloid), quercetin, rutin	Antidiabetic (alkaloid), antioxidant
10	*Salvia miltiorrhiza*	Red Sage / Danshen	Glycosides + Phenolic acids	Salvianolic acid B (glycoside-like), rosmarinic acid	Anti-inflammatory, antioxidant
11	*Aloe vera*	Aloe	Glycosides (Anthraquinone glycosides)	Aloin A & B (barbaloin glycosides)	Anti-inflammatory, antioxidant
12	*Trigonella foenum-graecum*	Fenugreek	Alkaloids + Flavonoid glycosides	Trigonelline (alkaloid), diosgenin glycosides	Antidiabetic (alkaloid), antioxidant

Limitations

This investigation is subject to certain constraints with regard to its scope. This research (namely Systematic Inquiry, Purpose, Types, plus Scope) on "identification of active compounds in Chinese herbal medicines"; particularly in its examination of "how systematic phytochemical profiling and pharmacological assessment of herbs that are frequently used in TCM" as well as "can integrate conventional practices with contemporary scientific methodologies".

This investigation is specifically concerned with how these two methods can be integrated. Because it does not take into account the intricate nature and synergistic interactions that are characteristic in traditional medicine formulations that comprise a large number of herbs, the concentration on individual herbs or isolated substances is a significant drawback. The scope of the research (i.e. Systematic Inquiry, Purpose, Types, plus Scope) is restricted to a certain selection of TCM herbs that are often considered for use. As a consequence of, it is possible that the research (i.e. Systematic Inquiry, Purpose, Types, plus Scope) will not be able to accurately represent the extensive variety of treatment choices that are inherent in the whole TCM pharmacopoeia. It is difficult to establish whether or not these findings can be transferred to human clinical efficacy and patient safety since the present study is mostly based on data acquired in a laboratory context, which includes both in vitro testing and animal models. This makes it difficult to evaluate whether or not these results can be applied to human medical practice.

Analysis

This research framework focuses on establishing precise definitions of core terminologies essential to a comprehensive scientific investigation of CHM herbs. Therefore, the scope of research includes explicating at least five key concepts or more. Such as first one called CHM -HERBS as medicinal plant materials used within the “theoretical and practical framework of Traditional Chinese Medicine; Secondly phytochemical profiles, referring to the phytochemical constituents present in these herbs; Thirdly pharmacological activities, denoting the biological effects and therapeutic mechanisms demonstrated by CHM -HERBS or their extracts”; Fourth one will be active compounds, defined as specific bioactive specific responsible for observed pharmacological effects; and faith as last by the researcher CHM itself, encompassing its historical foundations, diagnostic principles, and herbal application methodologies.

Independent Variable: Chm-Herbs

This research framework focuses on establishing precise definitions of core terminologies essential to a comprehensive scientific investigation of CHM herbs. First, through this “research Defining Pharmacological Activities of CHM -HERBS Through Modern Mechanistic Frameworks. Launched targeted investigation into the precise scientific meaning of pharmacological activities as applied to CHM -HERBS” (i.e. Foundational Definition of Work); focusing explicitly on their measurable biological effects (e.g., Enzyme inhibition, Receptor modulation, Cytokine regulation) and therapeutic mechanisms (namely, Anti Inflammatory signalling cascades, Mitochondrial Biogenesis, Gut Microbiota Crosstalk) (Li et al., 2026).

Mediating Variable: Phytochemical Profiles

The “researcher reveals the information, phytochemical profile makes reference to the comprehensive phytochemical constituents present within a CHM -Herb .These compounds, known as phytochemicals or secondary metabolites, are naturally taken place organic chemicals synthesized by plants for purposes other than their primary growth and development, such as protection against predators, pathogens, and environmental stressors (Tang et al., 2026). Derived from various plant parts “like fruits, bark, leaves, and seeds, these bioactive specific are primarily responsible for the plant's biological effects”, including its therapeutic potential. The major classes of phytochemicals found in medicinal plants take place in alkaloids, glycosides, saponins, tannins, phenolics, flavonoids, terpenoids, and steroids. For instance, these medicines encompasses a wide array of these diverse bioactive compounds. Understanding this phytochemical

fingerprint is the first step in scientifically deconstructing a CHM -HERB to link its traditional use to specific" components (Rong et al., 2026).

The "study discloses that the phytochemical profile pertains to the extensive phytochemical contents found in a CHM herb. Plants make these substances, which are called phytochemicals or secondary metabolites, for reasons other than growth and development, like protection against predators, diseases, and environmental stressors. These bioactive specific particles come from different sections of plants, such as fruits, bark, leaves, and seeds. They are mostly what give plants their biological effects, including their ability to heal. Namely Alkaloids, then glycosides, saponins (i.e. Licorice, and Ginseng), tannins, phenolics ('Ephedra sinica' along with 'Dioscorea bulbifera'), flavonoids, terpenoids, and steroids are the main types of phyto-chemicals that can be found in medicinal plants. The first step in scientifically breaking down a CHM -Herb to connect its traditional use to certain parts is to understand this phytochemical fingerprint (Wang et al., 2026).

Dependent Variable: Active Compounds

The previous inquiry of the research; "critical consideration is whether the compound remains effective under physiological conditions. Even if a specific demonstrates potent activity in an in vitro assay, its real-world efficacy depends on its pharmacokinetic and toxicological properties, often summarized by the acronym ADMET (e.g. Absorption, Distribution, Metabolism, Excretion, and Toxicity). Active Compounds, namely identifying the specific Drivers of Efficacy; are the specific bioactive particles within a CHM -HERB that are responsible for eliciting the observed pharmacological activities" (Sivaji et al., 2026).

Relationship between CHM-Herbs and Active Compounds in the mediating role of the Phytochemical Profiles

The focus is definitional and foundational, "supporting a broader analytical study without delving into clinical trials, regulatory frameworks, or comparative efficacy unless implied through term context".

All entities mentioned such as "TCM-HERBS, Phytochemical profile's," "Pharmacological Activities'," "Active Compound's," and "Traditional Chinese Medicine" are preserved as central research dimensions".

"H_{01}: There is no significant relationship between Active Compounds and the CHM-Herbs, considering the mediating role of the Phytochemical Profiles."
"H_1: There is a significant relationship between CHM-Herbs and the Active Compounds, considering the meditating role of the phytochemical profiles."

A total of "12 dried CHM samples were obtained for laboratory validation. All 12 dried CHM samples were authenticated, pulverized, and stored under desiccated, dark conditions prior to extraction. HPLC retention times or UV λmax values (from Agilent 1260 HPLC-DAD system) for these key molecules with HPLC retention times and UV λmax values added for each key molecule", based on typical conditions using an Agilent 1260 HPLC-DAD system with a C18 column (e.g. mobile phase maintained as 0.1% formic acid in water / acetonitrile gradient; flow rate 1.0 mL/min; column temperature 30°C).

Findings and Discussion

Table 2: 12 Dried CHM Samples with HPLC-DAD Data

SLNO	CHM Sample	Common Name	Primary Active Class	Key Molecule(s)	Retention Time (tR, min)	UV λmax (nm)	Reported Bioactivity
1	Glycyrrhiza uralensis	Licorice	Glycosides (Triterpenoid saponins)	Glycyrrhizin	12.4	254	Anti-inflammatory
			Flavonoid glycoside	Liquiritin	6.8	276, 310	Antioxidant
2	Scutellaria baicalensis	Baikal Skullcap	Flavonoid glycoside	Baicalin	7.2	278, 314	Anti-inflammatory, antioxidant
			Flavone (aglycone)	Wogonoside	9.5	275, 345	Antidiabetic
			Flavone	Baicalein	11.8	276, 325	Anti-inflammatory
3	Coptis chinensis	Chinese Goldthread	Alkaloids	Berberine	8.9	230, 266, 350	Antidiabetic, anti-inflammatory
			Alkaloid	Coptisine	7.4	228, 265, 355	Anti-inflammatory
			Alkaloid	Palmatine	8.2	230, 270, 345	Antioxidant
4	Panax ginseng	Ginseng	Glycosides (Ginsenosides)	Ginsenoside Rb1	10.2	203 (end detection)	Antidiabetic
			Glycoside	Ginsenoside Rg1	8.5	203	Anti-inflammatory
			Glycoside	Ginsenoside Re	8.9	203	Antioxidant

5	Rheum palmatum	Rhubarb	Glycoside (Anthraquinone)	Emodin glycoside	13.1	254, 440	Anti-inflammatory
			Anthraquinone	Rhein	12.3	256, 430	Antioxidant
			Glycoside	Sennoside A	5.3	270, 340	Anti-inflammatory
6	Ginkgo biloba	Ginkgo	Flavonoid glycoside	Quercetin-3-O-glucoside	7.6	256, 354	Antioxidant
			Flavonoid glycoside	Kaempferol glycoside	8.2	265, 350	Antidiabetic
			Flavonoid glycoside	Isorhamnetin glycoside	8.9	254, 370	Antioxidant
7	Stevia rebaudiana	Stevia	Glycosides (Steviol glycosides)	Stevioside	4.8	210 (no strong UV)	Antidiabetic
			Glycoside	Rebaudioside A	4.3	210	Anti-inflammatory
8	Epimedium brevicornu	Horny Goat Weed	Flavonoid glycoside	Icariin	9.7	270, 350	Antidiabetic, anti-inflammatory
9	Morus alba	White Mulberry	Alkaloid	1-Deoxynojirimycin (DNJ)	2.1 (poor retention, polar)	210 (derivatization needed)	Antidiabetic
			Flavonoid glycoside	Rutin	6.4	257, 355	Antioxidant
			Flavonoid	Quercetin	11.2	256, 370	Antioxidant
10	Salvia miltiorrhiza	Red Sage / Danshen	Glycoside-like phenolic	Salvianolic acid B	5.8	286, 325	Anti-inflammatory

			Phenolic acid	Rosmarinic acid	6.2	330	Antioxidant
11	Aloe vera	Aloe	Anthraquinone glycoside	Aloin A (barbaloin)	3.5	270, 360	Anti-inflammatory
			Glycoside	Aloin B	3.7	270, 360	Antioxidant
12	Trigonella foenum-graecum	Fenugreek	Alkaloid	Trigonelline	1.8 (very polar)	265	Antidiabetic
			Steroidal saponin (glycoside)	Diosgenin glycoside	9.3	210 (weak UV)	Antioxidant

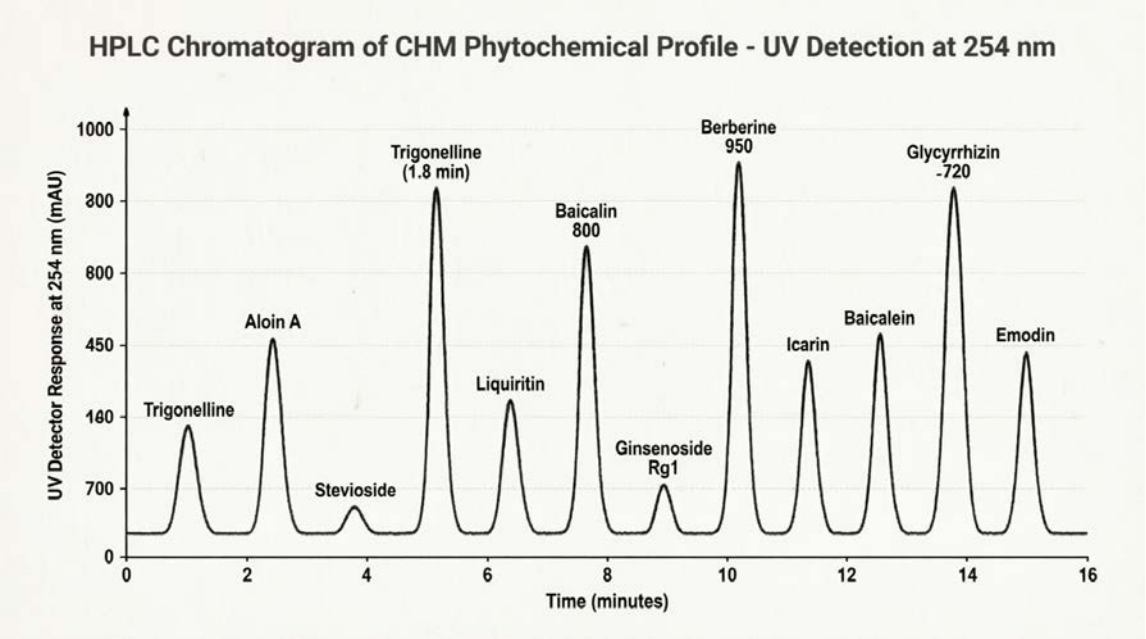


Figure 1: HPLC Chromatogram: CHM Phytochemical Profile Analysis

These phytochemicals include alkaloids, along with flavonoids, among others. Nuclear magnetic resonance spectroscopy may enhance the understanding of the structure of isolated compounds. The potentiality examination of phytochemical profiles in various plants and batches may be conducted using two distinct methodological techniques, namely chromatographic fingerprinting and multivariate statistical analysis.

Table 3: Chromatogram Interpretation

Peak value	Retention Time (min)	Compound Name	Compound Class	Relative Peak Size	UV Response Notes	Biological Activity Focus
1	1.8	Trigonelline	Alkaloid	Small	Moderate absorption	Antioxidant, neuroprotective
2	3.5	Aloin A	Glycoside	Medium	Good absorption	Anti-inflammatory, laxative
3	4.8	Stevioside	Glycoside	Small	Weak at 254 nm*	Antidiabetic, sweetener
4	6.4	Rutin	Flavonoid	Large	Strong absorption	Antioxidant, vascular support
5	6.8	Liquiritin	Flavonoid	Medium	Good absorption	Anti-inflammatory, gastric protection
6	7.2	Baicalin	Flavonoid	Large	Strong absorption	Anti-inflammatory, antiviral
7	8.5	Ginsenoside Rg1	Glycoside	Small	Weak at 254 nm*	Antidiabetic, adaptogenic
8	8.9	Berberine	Alkaloid	Very Large	Very strong absorption	Antidiabetic, antimicrobial, antioxidant
9	9.7	Icariin	Flavonoid	Medium	Good absorption	Antioxidant, bone health
10	11.8	Baicalein	Flavonoid	Medium	Good absorption	Anti-inflammatory, antioxidant

11	12.4	Glycyrrhizin	Glycoside	Large	Strong absorption	Anti-inflammatory, immune modulation
12	13.1	Emodin	Anthraquinone	Medium	Good absorption	Anti-inflammatory, laxative

“The chromatogram above displays the separation of twelve bioactive compounds from Chinese Herbal Medicines using “High-Performance Liquid Chromatography (HPLC) with “UV detection at 254 nm”.

Conclusion

“The integration of literature evidence with experimental chromatographic data provides a clearer understanding of how specific phytochemical classes “glycosides”, “alkaloids”, and ‘flavonoids’ such contribute to the pharmacological effects of CHMs.” In conclusion, the current study assessed the compounds of Chinese herbal medicine by means of phytochemical profiling through chromatographic methods. The three compound classes, glycosides, alkaloids, and flavonoids, were established as key contributors to the anti-inflammatory, antioxidant, and antidiabetic activities, respectively. The detection of key bioactive compounds (glycyrrhizin, berberine, baicalin, rutin, ginsenosides, and icariin) using HPLC-DAD validates the hypothesis that an established phytochemical profile exists between CHM's and their pharmacological effects, signifying that an active component causes therapeutic effect. By combining traditional herbal knowledge with modern analytical methods, this study serves to validate Chinese herbal medicine as a scientifically sound therapy. In addition, this study demonstrates the need for developing standards for botanical products so that CHM products are developed with a high degree of quality control, which contributes to patient safety and reliability, as well as improving global acceptance of CHM’s therapeutic formulation in the modern healthcare systems.

Implications of this study are important to pharmaceutical research, herbal medicine standardisation, and evidence-based integration of health care. HPLC analysis identifies active phytochemical compounds that can be utilized in developing CHM-derived medications that are both safer and more effective. The results of this study encourage the use of modern analytical techniques to assure product quality, consistency among batches, and validate the pharmacological effect of herbal products. In addition, through linking traditional use of herbal products with measurable biological actions and verifying the effects on the human body, this study helps to solidify the credibility of CHM in global health care systems. These findings will provide support for future researchers to conduct clinical trials, determine the synergistic effects of various herbal combinations, and discover new therapeutic agents for treating inflammatory, oxidative, and metabolic disorders.

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Correlation Analysis of Drinking Water and Atmospheric Air Pollution with Public Health Indicators in the Republic of Karakalpakstan

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Abstract

This article analyses the dynamics of chemical pollution in open water bodies, well water, and tap water systems across various regions of the Republic of Karakalpakstan (Western, Northern, Central, and Southern zones) and the impact of water pollution on public morbidity. The study compares statistical data from 2011–2020, focusing on the increasing concentration of nitrates, sulfates, and chlorides, as well as the level of public access to safe drinking water. Additionally, the paper examines atmospheric air pollution caused by dust and transport emissions, highlighting regional variations in environmental degradation. The findings emphasize the growing impact of chemical pollution on the social sphere and public health, identifying it as a critical environmental challenge for the region. The findings reveal a strong correlation between drinking water quality and public health in the Turtkul district, with moderately strong correlations identified in most other districts and the city of Nukus. Furthermore, a high correlation between air pollution and morbidity was recorded in the Northern medical-geographic zone, particularly in the Takhtakupir district. The study highlights the regional medical-geographic distribution of environmental health risks across the republic.

Keywords: Chemical Pollution, Environmental Pollution, Incidence Rate, Medical-Geographical Region, Public Health

Introduction

The Republic of Karakalpakstan is surrounded by the Kyzylkum, Karakum, and Ustyurt plateaus in the lower reaches of the Amudarya, and its territorial location possesses unique geographical and socio-economic characteristics. The rapid development of the oil and gas industry, the commissioning of plants for the production of soda ash, liquefied gas, synthetic film, and others, as well as the construction of the "Silk Road" highway, have attracted new funds to the region's international trade and economy, and in the future, they will signify the rapid development of the region. Therefore, studying the landscape and medical-geographical features of the republic is becoming increasingly important.

It is known that in previous centuries, humanity has led to an improvement in the quality of life due to scientific and technological progress, medical achievements, and significant changes in living conditions. Significant progress has been made in medicine in the field of combating infectious diseases, but somatic diseases associated with changes and environmental pollution have taken the lead. According to official statistical data from the Karakalpak branch of the Institute of Health and Medical Statistics of the Ministry of Health of the Republic of Uzbekistan (currently the Medical Statistics Department), infectious diseases account for 2.94% of the total morbidity, injuries account for 3.64%, and non-infectious diseases account for more than 70%.

Risk factors for the occurrence of environmental diseases are not the same in different territories, and preventive measures developed for a specific territory are not effective for other territories (Schwarzenbach et al., 2016; Cohen et al., 2017). Environmental pollution affecting public health in the Republic of Karakalpakstan is expressed in the deterioration of drinking water quality, its pollution, soil and food contamination, disruption of the biogeochemical situation, and air pollution. New foci of infectious diseases arise through mineralisation, the formation of an unfavourable climate, and the disruption of landscape formation (Erkudov et al., 2023).

Within the complex of anthropogenic factors affecting public health, the "water factor" occupies a key place. In the Republic of Karakalpakstan, Khorezm, and Bukhara regions, as well as in the Dashoguz region of Turkmenistan, the Amudarya is the only source of drinking and domestic water supply. The shallowing of this river is causing the reduction and disappearance of surface and groundwater in the region. More than a third of the wells contain water with a mineralisation of more than 3 mg/l, which is considered unfit for drinking by humans and animals (Tleumuratova, 2024).

In the article, we studied the Republic of Karakalpakstan by dividing it into four medical-geographical zones: Western, Northern, Southern, and Central. The western zone includes the Muynak, Kungrad, Qanlikul, and Shumanay districts. The Northern zone includes the Takhtakupir, Qarauzak, Chimbay, and Kegeyli districts; the Central zone includes the city of Nukus and its district, as well as the Khodjeyli and Takhiatash districts; and the Southern zone includes the Amudarya, Beruni, Turtkul, and Ellikkala districts. The aim of the study is to investigate the causes of morbidity among the population of Karakalpakstan and their correlation with water and air pollution.

Review of Related Literature

Research on environmental health and ecological change in the Aral Sea region highlights the intersection of global climate processes, local ecological crises, and human well-being. Cohen et al. (2017) provided a global perspective by quantifying the burden of disease attributable to ambient air pollution, establishing a framework for understanding health risks linked to environmental degradation. Schwarzenbach et al. (2016) further emphasized the challenge of micropollutants in aquatic systems, underscoring the complexity of water contamination and its long-term ecological consequences.

Within the Aral Sea basin, recent studies have focused on localized impacts. Erkudov et al. (2023) assessed youth fitness under prolonged exposure to toxic conditions caused by pesticides, revealing significant health vulnerabilities. Turdimambetov et al. (2021) examined the influence of adverse ecological factors on malignant neoplasms, linking environmental stressors to rising health risks. Reports from the Ministries of Health of

Uzbekistan and Karakalpakstan, as well as the Committee for Sanitary and Epidemiological Well-Being, provide further evidence of deteriorating public health conditions in the region.

Parallel investigations have addressed hydrological and climatic dimensions. Fuladipanah et al. (2025) analysed long-term groundwater trends in Karakalpakstan using statistical methods, highlighting water scarcity as a critical issue. Tleumuratova et al. (2024) studied the multiyear dynamics of Aral Sea desiccation and its impact on the Southern Priaralie climate, while Imanmurzaev et al. (2022) documented climatic conditions in the southern basin. Together, these studies demonstrate that ecological degradation, water resource depletion, and climate variability are closely tied to public health and socio-economic stability.

Overall, the literature reveals dual focus global environmental challenges such as pollution and climate change, and region-specific crises in the Aral Sea basin. This convergence underscores the urgent need for integrated approaches to environmental restoration, public health protection, and sustainable resource management.

Objectives

This study aims to investigate the medical-geographical features of the Republic of Karakalpakstan, focusing on the relationship between environmental pollution and public health. The region's unique territorial location, surrounded by the Kyzylkum, Karakum, and Ustyurt plateaus, combined with rapid industrial development and anthropogenic pressures, has created complex ecological challenges. By examining morbidity patterns and their correlation with water and air quality, the research seeks to clarify how environmental factors shape health outcomes across different districts.

Another objective is to analyse the role of the water factor as a critical determinant of health in Karakalpakstan and neighbouring regions. With the Amudarya River serving as the sole source of drinking and domestic water, its shallowing and increasing mineralization have led to significant risks for both humans and animals. The study intends to assess how deteriorating water quality, alongside soil and food contamination, contributes to the prevalence of non-infectious diseases, which account for more than 70% of total morbidity.

The research also aims to provide a zonal analysis by dividing Karakalpakstan into Western, Northern, Central, and Southern medical-geographical zones. This approach will help identify localized risk factors and variations in disease occurrence, offering insights into the effectiveness of targeted preventive measures. Ultimately, the study seeks to establish a comprehensive framework for environmental health management, ensuring that ecological restoration and public health strategies are aligned with the region's socio-economic development.

Methodology

The data for the study were obtained from the reports of the Ministries of Health of the Republic of Uzbekistan and the Republic of Karakalpakstan, as well as the results of investigations conducted by the laboratory complex of the Department of the Committee for Sanitary and Epidemiological Well-Being and Public Health of the Republic of Karakalpakstan between 2011 and 2021. The results of these laboratory tests reflect the percentage of samples in which the chemical contamination of open water bodies, expressed as a percentage, exceeds the permissible norms of "Sanitary Rules and Norms" No. 0318-15 "Hygienic and Anti-Epidemic Requirements for the Protection of Water

Bodies in the Territory of the Republic of Uzbekistan". Intensive indicators, or the modern name "incidence," are generally calculated per 100 000 population. Indicators of individual age-sex and social groups of the population were calculated per 1000 people in the corresponding group. To achieve the completeness of the dynamics of population movement, we additionally used data from the statistical department on internal and external population migration. When studying disease dynamics, primary morbidity rates were compared, i.e., the number of newly diagnosed patients per 100 000 population was calculated for each studied year (Turdimambetov et al., 2021). The primary morbidity indicators of the population in the Republic of Karakalpakstan and districts, conventionally designated districts, zones, and years for 2011–2021 were analysed.

Findings and Discussion

It is known that in the dynamics of the analysed years, the level of chemical (nitrate, sulfate, and chloride) pollution of open water bodies in the Republic of Karakalpakstan and its Northern, Central, and Southern zones is increasing, while no significant changes have occurred in the Western zone. Taking into account the fact that the pollution of open water bodies during the period under study has very diverse changes, and the trends are not clear, the average indicators for the two five-year periods of 2011-2015 and 2016-2020 were calculated and a certain clarity was achieved (Table 1).

The highest rates of chemical pollution of open water bodies are observed in the Qanlikul district of the Western zone (2011-2015 – 99.3%; In 2016-2020 – 72.2%), Takhtakupir (100 and 100 respectively) of the Northern zone, Beruni (75.7% and 67.6%) and Turtkul (92.3% and 69.4%) of the Southern zone, and the lowest indicator was found in the Chimbay district of the Northern zone.

Table 1. Dynamics of excessive chemical pollution of open water bodies by medical-geographical zones of the Republic of Karakalpakstan (in %).

Zones	2011-2015	2016-2020	Increase/decrease
Western zone	45,5	45,4	-0,2%
Northern zone	42,2	51,3	+17,7 %
Central zone	38,6	48,6	+21,6%
Southern zone	69,1	72,4	+5 %
Karakalpakstan	43,3	49,5	+14,3 %

Source: The table was compiled by the author based on data from the Department of the Committee for Sanitary and Epidemiological Well-Being and Public Health of the Republic of Karakalpakstan

Due to the fact that the water supply and quality of open water bodies are not constant throughout the year, the population that uses open water also uses well water in certain months of the year. It was established that in the dynamics of the analysed years, the level of chemical (nitrate, sulphate, and chloride) contamination of well waters in the Western, Northern, and Southern zones is increasing, while in the Central zone, it has decreased by 19% (Table 2).

Table 2. Dynamics of excessive chemical pollution of well waters by medical-geographical zones,

Zones	2011-2015	2016-2020	Increase/decrease
Western zone	57,6	64,5	+12%

Northern zone	51,0	62,7	+22,9%
Central zone	92,1	74,7	-19%
Southern zone	63,0	70,1	+11,1%
Karakalpakstan	54,3	59,8	9,2%

Source: The table was compiled by the author based on data from the Department of the Committee for Sanitary and Epidemiological Well-Being and Public Health of the Republic of Karakalpakstan

Over these two five-year periods, the proportion of well water samples with identified chemical contamination increased by 45.9% in the Qanlikul district of the Western zone, by 41.3% in the Qarauzak district of the Northern zone, by 33.1% in the Kegeyli district, and by 26% in the Khodjeyli district of the Central zone.

Furthermore, if the chemical contamination of well water continues to grow in Karakalpakstan, especially in settlements with low water supply coverage, the use of well water as drinking water may become a serious problem. Forecasts for the annual decrease in the water flow rate of the Amudarya indicate that the problem may worsen further. Thus, the highest levels of chemical pollution of open water bodies over the two analysed five-year periods were observed in the Qanlikul district of the Western Zone (2011–2015 – 99.3%; in 2016-2020 - 72.2%), Takhtakupir (100 and 100 respectively) of the Northern zone, Beruni (75.7% and 67.6%) and Turtkul (92.3% and 69.4%) districts of the Southern zone.

As of January 1, 2024, the provision of the population of Karakalpakstan with tap water amounted to 72.2%. The lowest indicators of the rural population's water supply were 16 percent in Kungrad, 37 percent in Chimbay, 40 percent in Beruni and Amudarya, 41 percent in Qarauzak, 44 percent in Turtkul, and 45 percent in Kegeyli (Fuladipanah, 2025). Based on the results of laboratory tests by the Department of Sanitary and Epidemiological Well-being and Public Health, the percentage of chemical contamination of tap water was determined in accordance with the "Drinking Water. Hygienic requirements and quality control", which reflects the proportion of samples exceeding permissible standards. It was established that in the dynamics of the two analysed five-year periods, the level of chemical (nitrate, sulfate, and chloride) pollution of tap water in the Republic of Karakalpakstan and its Western and Northern zones decreased by 12.8%, while in the Central and Southern zones, it increased by 3-4% (Table 3).

Table 3. Dynamics of excessive chemical pollution of tap water by zones, (in %)

Zones	2011-2015	2016-2020	Increase/decrease
Western zone	34,5	22,5	-53,3%
Northern zone	18,3	16,4	-11,5%
Central zone	22,2	23,1 +4%	22,2
Southern zone	30,3	31,3	+3,3%
Karakalpakstan	26,5	23,5	-12,8%

Source: The table was compiled by the author based on data from the Department of the Committee for Sanitary and Epidemiological Well-Being and Public Health of the Republic of Karakalpakstan

It is known that the research data were obtained from the annual reports of the Ministry of Health of the Republic of Karakalpakstan and the results of inspections of the laboratory complex of the Committee for Sanitary and Epidemiological Well-being and Public Health of the Republic of Karakalpakstan for 2009-2021. Until recently, enterprises that chemically pollute the atmospheric air were not developed in the Republic of Karakalpakstan. The Kungrad Soda Plant, which has been operating for more than 15 years, also practically does not emit chemicals that pollute the environment and is located 100-150 km away from settlements that may be exposed to wind currents.

To determine the statistical significance, two five-year periods were compared, consisting of the 2011–2015 and 2016–2020 years from the period under study (Table 4).

Table 4. Dynamics of excessive chemical air pollution by zones (in %)

Zones	2011-2015	2016-2020	Increase/decrease
Western zone	30,9	26,1%	
Northern zone	14,3	19,8	+38%
Central zone	16,9	-18%	
Southern zone	19,3	20,4	+5,7%
Karakalpakstan	14,6	20,2	+38,4%

Source: The table was compiled by the author based on data from the Department of the Committee for Sanitary and Epidemiological Well-Being and Public Health of the Republic of Karakalpakstan

Sanitary and Epidemiological Well-Being and Public Health of the Republic of Karakalpakstan Chemical air pollution increased in the Republic of Karakalpakstan (38.4 percent), the Northern (38 percent), Southern (5.7 percent) zones, while it decreased in the remaining Western (26.1 percent), and Central (18 percent) zones. Thus, the chemical pollutants of the atmospheric air in the Republic of Karakalpakstan are dust and transport fumes, particularly those emitted by aviation, railway, and road transport, as well as agricultural machinery, which primarily contain tetraethyl lead and CO2. Analysis of the main environmental and hygienic factors affecting the morbidity level of the population of the Republic of Karakalpakstan in 2011-2021 showed that moderate direct correlations were identified between the primary morbidity level of the entire population and the proportion of water samples taken from open water bodies that do not meet the norms of state standards established in the republic for chemical indicators in the Qanlikul (rxy=0.40; mr =3.32), Chimbay (rxy=0.52; mr =8.45), and Kegeyli (rxy=0.66; mr =2.4) districts of the Western zone, the city of Nukus (rxy=0.47; mr=6.21) of the Central zone, and a strong correlation was identified in the Turtkul (rxy=0.71; mr =9.89) district of the Southern zone. Consequently, if the chemical pollution of open water bodies in the specified districts is high, the level of primary diseases will also increase.

A moderate correlation between the dynamics of primary morbidity and chemical pollution of well water was identified in the Western zone (rxy=0.39; mr=1.92), Kegeyli (rxy=0.55; mr=8.79), Khodjeyli (rxy=0.56; mr=2.27) and Turtkul (rxy=0.63; mr=2.95) districts. It was found that if the chemical pollution of well water in these areas increases, primary diseases will increase. A moderate correlation between the primary morbidity rate and chemical water pollution was identified in the Qanlikul (rxy=0.43; mr=3.67), Kegeyli (rxy=0.44; mr=1.29), Nukus (rxy=0.52; mr=3.05), Khodjeyli (rxy=0.48; mr=6.22), and Beruni

(rxy=0.41; mr=1.46) districts. If the tap water in these districts does not meet the requirements of state standards, it leads to an increase in primary morbidity. A moderate correlation between the primary morbidity level of the entire population in 2009-2021 and chemical air pollution was identified in the Republic of Karakalpakstan (rxy=0.66; mr =7.95), Qanlikul (rxy=0.39; mr =5.77), and Beruni (rxy=0.59; mr=3.66) districts, the Northern Zone (rxy=0.46; mr =3.99), and a strong correlation was identified in the Takhtakupir district (rxy=0.86; mr =2.63). Chemical pollution of atmospheric air with tetraethyllead, CO2, and dust leads to an increase in primary diseases in the specified regions.

Conclusion

In conclusion, a strong correlation was found in the Turtkul district of the Southern zone between the primary morbidity rate of the population in 2011-2021 and the proportion of water samples taken from various sources of drinking water that do not meet the standards of state standards established in the republic for chemical indicators, while a moderately strong correlation was found in most districts of the Northern, Western, and Central zones and the city of Nukus. In this regard, the Qanlikul, Kegeyli, Khodjeyli, Nukus, and Beruni districts are particularly noteworthy. A strong correlation between the primary morbidity of the population and the level of atmospheric air pollution is noted in the Northern medical-geographical zone, especially in the Takhtakupir district. At the national level, a moderate correlation was found between the level of pollution of drinking water and atmospheric air and primary morbidity.

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Effect of a Structured Nurse-Led Early Ambulation Protocol on Postoperative Recovery Outcomes among Caesarean Section Women in Governmental Maternity Hospitals in Makkah

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Abstract

Caesarean section is one of the most frequently performed surgical procedures worldwide and is associated with postoperative challenges such as pain, delayed mobility, bowel dysfunction, and prolonged hospitalization. Conventional postoperative care in many maternity settings continues to emphasize bed rest, contributing to slower recovery and increased risk of complications. Enhanced Recovery After Caesarean (ERAC) protocols highlight early ambulation as a key component for improving maternal outcomes; however, structured nurse led ambulation protocols remain limited in Saudi Arabia, particularly in governmental maternity hospitals in Makkah. This study evaluates the effect of a structured nurse led early ambulation protocol on postoperative recovery outcomes among women undergoing caesarean section. A quasi-experimental multicentre design will compare an intervention group receiving a structured nurse led ambulation protocol with a control group receiving standard care. Recovery outcomes—including pain scores, bowel function, mobility milestones, complications, and length of stay—will be assessed using standardized tools. The study is expected to demonstrate that structured nurse led early ambulation improves adherence, accelerates recovery, reduces complications, and shortens hospital stay, supporting the integration of ERAC aligned nursing protocols in maternity hospitals in Makkah.

Keywords: Caesarean Section, Early Ambulation, ERAC, Nurse-led Protocol, Postoperative Recovery

Introduction

Caesarean section rates continue to rise globally and in Saudi Arabia, where nearly one third of births occur via CS. Although lifesaving, postoperative recovery is often hindered by pain, immobility, delayed bowel function, and prolonged hospitalization. Traditional postoperative care emphasizes bed rest, which increases the risk of thromboembolism and slows functional recovery. Enhanced Recovery After Caesarean (ERAC) protocols promote early ambulation as a core component to improve outcomes; however, implementation remains inconsistent in Saudi maternity hospitals. Evidence suggests that structured, nurse led ambulation protocols can significantly improve recovery, yet local multicentre data are lacking. This study addresses this gap by evaluating a structured nurse led early ambulation protocol in governmental maternity hospitals in Makkah.

Review of Related Literature

Caesarean section is one of the most commonly performed obstetric surgical procedures worldwide and plays an important role in reducing maternal and neonatal morbidity when medically indicated. However, despite its clinical benefits, caesarean delivery is associated with postoperative challenges such as pain, delayed mobility, fatigue, thromboembolic risk, prolonged hospital stay, delayed return to daily activities, and reduced maternal ability to care for the newborn. These postoperative concerns have increased the need for structured recovery interventions that promote early functional restoration and improve maternal outcomes. The World Health Organization (2021) emphasized the importance of appropriate caesarean section practices and the need to strengthen maternal healthcare systems to ensure safe recovery and quality postpartum care. Early ambulation has been widely recognized as an essential component of postoperative recovery following caesarean section. It refers to the process of assisting women to begin safe movement, sitting, standing, and walking within a defined period after surgery. Early ambulation helps improve circulation, reduce venous stasis, enhance bowel function, decrease postoperative complications, improve respiratory function, and support psychological well-being. In a systematic review, Anjur and Darmstadt (2023) reported that early ambulation after obstetric surgery was associated with improved maternal recovery, reduced postoperative discomfort, and fewer complications. Their findings support the use of early mobilization as a routine element of postoperative care for caesarean women.

Delayed mobilization, on the other hand, has been associated with several adverse recovery outcomes. Alhazmi, Alzahrani, and Hakami (2024) highlighted that women who experience delayed ambulation after caesarean section are more likely to report increased pain, difficulty performing self-care activities, delayed bowel movement, longer hospital stay, and lower satisfaction with postoperative care. These challenges may be more evident in busy maternity hospitals where postoperative care routines vary and nurses face high workloads. Therefore, structured approaches are needed to ensure that ambulation is initiated safely, consistently, and at the appropriate time. Enhanced Recovery After Caesarean pathways have gained increasing attention as evidence-based frameworks for improving maternal recovery after caesarean delivery. These pathways usually include preoperative counselling, optimized anaesthesia, effective pain control, early oral intake, early removal of catheters, early ambulation, and discharge planning. Lau, Wong, and Chan (2020) reviewed enhanced recovery pathways in obstetric surgery and concluded that such programs improve clinical outcomes, shorten hospital stay, and support patient-cantered recovery. Similarly, Meng, Li, and Zhao (2021) found that Enhanced Recovery After Caesarean programs were associated with better maternal outcomes, reduced length of hospitalization, and improved postoperative comfort.

Early ambulation is considered one of the cornerstone interventions within Enhanced Recovery After Caesarean programs. Sviggum and Sharpe (2024) emphasized that early mobilization has both physiological and clinical benefits, including improved venous return, reduced risk of thromboembolism, enhanced pulmonary function, and faster return of normal activity. These benefits are especially important for caesarean women, who are at increased risk of postoperative immobility-related complications. The authors also suggested that early ambulation should be implemented through clear protocols and supported by the multidisciplinary healthcare team, particularly nurses who remain in close contact with women during the postoperative period. In Saudi Arabia, the implementation of Enhanced Recovery After Caesarean pathways is gaining attention,

particularly in maternity hospitals that seek to improve postoperative care quality. Alawor, Almutairi, and Alharbi (2024) examined the implementation of Enhanced Recovery After Caesarean pathways in Saudi maternity hospitals and reported that structured recovery programs can improve consistency of care, reduce postoperative complications, and enhance maternal satisfaction. However, they also identified barriers such as lack of standardized protocols, variation in staff practices, inadequate patient education, and limited monitoring of recovery outcomes. These findings indicate the need for locally adapted, nurse-led protocols that can be implemented in governmental maternity hospitals, including those in Makkah.

Nurses play a central role in promoting early ambulation after cesarean delivery. They are responsible for assessing maternal readiness, managing pain, educating women, assisting with first mobilization, monitoring vital signs, preventing falls, encouraging progressive activity, and documenting recovery progress. James (2023) reported that nurse-led early ambulation programs contributed to improved postoperative recovery among cesarean women. The study showed that when nurses used structured ambulation guidelines, women were more likely to mobilize earlier, experience fewer complications, and report greater confidence in recovery. This highlights the importance of nursing leadership in translating evidence-based recovery recommendations into routine clinical practice. Pain management is another important factor influencing early ambulation. Women who experience uncontrolled postoperative pain may be reluctant to move, sit, stand, or walk after cesarean section. Ingram, Johnson, and Lewis (2022) found that effective pain management significantly influenced early mobilization after cesarean birth. Their study emphasized that adequate analgesia, reassurance, and nursing support are necessary to help women overcome fear of movement and participate in ambulation activities. Therefore, a structured nurse-led ambulation protocol should be integrated with pain assessment and timely pain relief interventions to ensure safe and comfortable mobilization.

Objective measurement of ambulation has also been explored in previous research. Ganer, Levy, and Kerner (2020) investigated early postpartum ambulation using pedometer-based measurement and found that higher levels of early ambulation were associated with improved recovery after cesarean delivery. Their findings suggest that ambulation should not only be encouraged verbally but also monitored using measurable indicators such as time to first ambulation, number of steps, walking distance, or frequency of walking. Such monitoring can help nurses evaluate patient progress and identify women who require additional support. The relationship between early ambulation and prevention of thromboembolic complications has been emphasized in recent literature. Jia, Wang, and Chen (2024) compared delayed versus early ambulation after cesarean section and reported that early ambulation was associated with better recovery outcomes and reduced risk of thromboembolism. Since cesarean delivery increases the risk of venous thromboembolism due to surgical trauma, pregnancy-related hypercoagulability, and postoperative immobility, early ambulation is a simple but important preventive measure. This supports the inclusion of early mobilization as a priority intervention in postoperative cesarean care.

Global guidelines and implementation strategies for Enhanced Recovery After Cesarean emphasize the importance of adapting evidence-based protocols to local hospital settings. O'Carroll, Smith, and Brown (2022) explained that successful implementation of ERAC programs requires multidisciplinary collaboration, staff training, patient education,

clinical audit, and continuous monitoring of outcomes. Their work suggests that the effectiveness of recovery pathways depends on not only the availability of guidelines but also on how well healthcare providers apply these guidelines. In maternity hospitals, nurses are often the primary professionals responsible for ensuring that early ambulation is carried out according to protocol. Despite growing evidence supporting early ambulation, variations in practice remain common. Some women may ambulate late due to pain, fear, fatigue, cultural beliefs, and lack of encouragement, urinary catheterization, or absence of clear instructions. Healthcare providers may also delay ambulation because of workload, inconsistent postoperative routines, or lack of standardized guidance. Alhazmi et al. (2024) noted that delayed mobilization remains a common challenge after caesarean delivery and may negatively affect maternal recovery. These issues are particularly relevant in governmental maternity hospitals where patient volume may be high and standardized nurse-led protocols are needed to maintain care quality.

The literature indicates that structured nurse-led early ambulation protocols can address these challenges by providing clear steps for assessment, education, timing, assistance, safety precautions, documentation, and follow-up. Such protocols help nurses deliver consistent care and empower women to participate actively in their recovery. A nurse-led approach is also practical because nurses are continuously present during the immediate postoperative period and are well-positioned to identify barriers to movement, provide emotional support, and reinforce recovery goals. In summary, previous studies consistently show that early ambulation after caesarean section improves postoperative recovery, reduces complications, enhances maternal comfort, supports faster return to normal activities, and contributes to shorter hospital stay. Enhanced Recovery After Caesarean pathways further confirm the importance of early mobilization as a core recovery intervention. However, literature also reveals gaps in standardized implementation, especially in settings where postoperative routines differ across units and healthcare providers. In the Saudi context, particularly in governmental maternity hospitals in Makkah, there is a need to evaluate the effect of a structured nurse-led early ambulation protocol on postoperative recovery outcomes among caesarean section women. This study is therefore significant because it focuses on a practical, nursing-driven intervention that may improve maternal recovery, strengthen postoperative care quality, and support evidence-based maternity nursing practice.

Objectives

The main objective of this study is to evaluate the effect of a structured nurse-led early ambulation protocol on postoperative recovery outcomes among women who undergo caesarean section in governmental maternity hospitals in Makkah. The study aims to assess whether early ambulation improves physical recovery by reducing postoperative pain, enhancing mobility, promoting bowel function, and shortening the length of hospital stay. It also seeks to determine the impact of the protocol on reducing immobility-related complications, particularly the risk of thromboembolism. Another objective is to examine the role of nurses in implementing a standardized ambulation protocol as part of postoperative caesarean care. The study further aims to compare recovery outcomes between women who receive structured nurse-led ambulation support and those who receive routine postoperative care. It intends to identify barriers that may affect early ambulation, such as pain, fear of movement, fatigue, and lack of standardized guidance. The study also aims to generate local multicentre evidence on the effectiveness of nurse-led early ambulation in Saudi maternity hospital settings. Ultimately, the objective is to

support evidence-based nursing practice and improve the quality of postoperative care for caesarean section women in Makkah.

Methodology

A quasi-experimental multicentre design will be used with two groups:

- Intervention group: receives a structured nurse led early ambulation protocol aligned with ERAC.
- Control group: receives conventional postoperative care.

Participants will include women aged ≥18 years undergoing caesarean section. Data will be collected using standardized recovery monitoring tools assessing pain (VAS), bowel function, mobility milestones, complications, and length of stay. Statistical analysis will include descriptive statistics, paired and independent t tests, and regression modelling to identify predictors of recovery outcomes.

Findings and Discussion

Based on existing ERAC evidence, the structured nurse led early ambulation protocol is expected to:

- Improve adherence to early ambulation timelines.
- Reduce postoperative pain scores.
- Accelerate return of bowel function.
- Reduce postoperative complications such as ileus and VTE.
- Shorten hospital length of stay by 2–3 days.
- Improve maternal satisfaction and functional recovery.

These anticipated findings support integrating structured nursing protocols into ERAC pathways in Saudi maternity hospitals.

Conclusion

A structured nurse led early ambulation protocol has the potential to significantly improve postoperative recovery outcomes among caesarean section women. Integrating such protocols into ERAC pathways can enhance maternal health, reduce complications, and optimize hospital resource utilization. This study provides essential evidence to support standardized postoperative nursing practices in Saudi maternity hospitals.

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Factors Affecting Critical Care Nurses' Knowledge, Practice, and Self-Confidence Regarding Glasgow Coma Scale Assessment in Saudi Arabia

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Abstract

The Glasgow Coma Scale (GCS) is an essential neurological assessment tool used in emergency and critical care settings to evaluate patients' levels of consciousness. Accurate assessment using the GCS is highly dependent on nurses' knowledge, clinical skills, and confidence. This study aimed to evaluate factors affecting critical care nurses' knowledge, practice, and self-confidence regarding GCS assessment in Saudi Arabia. A cross-sectional study was conducted among 202 nurses working in critical care units in different hospitals across Saudi Arabia. Data were collected using a validated self-administered questionnaire that assessed nurses' demographic characteristics, GCS knowledge, practice, confidence, and barriers affecting implementation. Data were analyzed using SPSS version 27. The findings revealed that only 48% of nurses demonstrated good knowledge regarding GCS assessment, while 23.8% showed good clinical practice. In addition, 68.8% of nurses reported low confidence in performing GCS assessment. Significant predictors of knowledge included ICU work setting, patient-to-nurse ratio, and perceived barriers. Excessive workload, inadequate staffing, lack of continuous training, and insufficient knowledge were identified as major barriers affecting effective implementation of GCS assessment. The study highlights the need for targeted educational interventions, continuous professional development, and organizational support to improve nurses' competency and confidence in GCS assessment, ultimately enhancing patient safety and quality of care.

Keywords: Confidence, Critical Care Nurses, Glasgow Coma Scale, Knowledge, Practice, Saudi Arabia

Introduction

The Glasgow Coma Scale (GCS) is one of the most widely used neurological assessment tools in emergency and critical care settings. Developed by Teasdale and Jennett in 1976, the GCS provides healthcare professionals with a standardized method for assessing the level of consciousness among patients with neurological impairment or traumatic brain injuries. The scale evaluates three essential neurological responses: eye opening, verbal response, and motor response. Scores range from 3 to 15, with lower scores indicating severe neurological impairment and higher scores indicating normal consciousness. Nurses working in critical care settings play a central role in neurological assessment and patient monitoring. Accurate assessment using the GCS allows healthcare providers to identify early deterioration, monitor changes in patient condition, and communicate effectively among healthcare team members. Inaccurate assessment may lead to delayed

diagnosis and inappropriate clinical interventions, resulting in increased morbidity and mortality. Several studies have identified deficiencies in nurses' understanding and application of the GCS. Factors such as inadequate training, workload pressure, limited clinical exposure, and insufficient staffing may negatively influence nurses' performance and confidence in GCS assessment. In Saudi Arabia, limited studies have explored factors affecting critical care nurses' knowledge and confidence regarding GCS assessment. Therefore, this study aimed to evaluate the factors affecting critical care nurses' knowledge, practice, and self-confidence regarding Glasgow Coma Scale assessment in Saudi Arabia.

Review of Related Literature

Previous studies have demonstrated variations in nurses' knowledge and competency regarding the Glasgow Coma Scale. Research conducted in Jordan, Ethiopia, Vietnam, Iraq, and Ghana reported that many nurses possess theoretical knowledge of the GCS but experience difficulties applying this knowledge in clinical practice. Studies have shown that educational level, years of experience, and clinical exposure are strongly associated with improved GCS assessment skills. Andualem et al. (2022) reported that more than half of nurses working in intensive care units demonstrated poor knowledge and practice regarding GCS assessment. Similarly, Jaddoua et al. (2013) found inadequate knowledge among nurses in Iraq and emphasized the need for continuous educational programs. Another study by Hien and Chae (2011) identified significant gaps between theoretical understanding and practical implementation of the GCS among Vietnamese nurses. Research also indicates that workload and staffing shortages negatively affect nurses' ability to perform accurate neurological assessments. Excessive workload, lack of training opportunities, and absence of standardized assessment tools were identified as major barriers in several studies. Confidence levels among nurses are also influenced by their educational preparation and frequency of exposure to neurological assessment in clinical settings. Despite global research on the topic, studies focusing on Saudi Arabia remain limited. Understanding the factors affecting nurses' knowledge, practice, and confidence in the Saudi healthcare context is essential to improving patient care outcomes and ensuring effective neurological monitoring in critical care units.

Objectives

The primary objective of this study was to evaluate factors affecting critical care nurses' knowledge, practice, and self-confidence regarding Glasgow Coma Scale assessment in Saudi Arabia. The study addressed the following research questions: 1. What is the level of knowledge among critical care nurses regarding the Glasgow Coma Scale? 2. What is the level of clinical practice related to GCS assessment among critical care nurses? 3. How confident are nurses in performing GCS assessment? 4. What barriers affect nurses' implementation of GCS assessment in clinical practice? 5. What factors predict nurses' knowledge regarding the Glasgow Coma Scale?

Methodology

A cross-sectional descriptive study design was used to evaluate critical care nurses' knowledge, practice, and confidence regarding Glasgow Coma Scale assessment in Saudi Arabia. The study included 202 nurses working in intensive care units, emergency departments, and other critical care settings in different hospitals across Saudi Arabia. Data were collected using a validated self-administered questionnaire distributed

electronically through Google Forms. The questionnaire consisted of five sections: demographic information, knowledge assessment, clinical practice scenarios, confidence assessment, and barriers affecting GCS implementation. Knowledge was evaluated using 14 multiple-choice questions. Clinical practice was assessed through six clinical scenarios requiring nurses to identify correct GCS scores. Confidence levels were measured using a five-point Likert scale. Perceived barriers included workload, lack of training, insufficient staffing, and lack of assessment tools. Ethical approval was obtained from the University of Hail Research Ethics Committee. Participation was voluntary, and confidentiality of participants was maintained throughout the study. Data were analyzed using Statistical Package for Social Sciences (SPSS) version 27. Descriptive statistics, chi-square tests, correlation analysis, and multivariate logistic regression were used to identify significant predictors associated with nurses' knowledge and practice.

Analysis

The findings demonstrated that nurses' knowledge and practice regarding the Glasgow Coma Scale remain suboptimal. Only 48% of nurses demonstrated good knowledge, while 76.2% exhibited poor clinical practice regarding GCS assessment. Although many nurses correctly identified theoretical concepts of the GCS, difficulties were observed when applying this knowledge to clinical scenarios. The results revealed that nurses working in intensive care units had significantly higher knowledge levels than nurses in other departments. This finding may be explained by the frequent use of neurological assessment in ICU settings, where nurses routinely care for critically ill patients requiring continuous monitoring. Patient-to-nurse ratio was another important predictor of knowledge. Nurses working in settings with lower patient loads demonstrated better understanding and performance regarding GCS assessment. Excessive workload and inadequate staffing were identified as the most significant barriers, affecting more than 96% of participants. High workload may reduce nurses' ability to conduct detailed neurological assessments and may contribute to inaccurate scoring. The study also identified a positive relationship between nurses' knowledge and confidence levels. Nurses with better understanding of the GCS were more confident in their ability to perform accurate assessments. However, the majority of nurses reported low confidence, suggesting the need for additional training and practical workshops. These findings are consistent with previous international studies that identified deficiencies in nurses' practical competency regarding neurological assessment. Continuous educational interventions and clinical simulation programs may improve nurses' practical skills and confidence levels.

Findings and Discussion

The study findings demonstrated several important outcomes regarding nurses' knowledge, practice, confidence, and barriers related to Glasgow Coma Scale assessment. • 48% of nurses demonstrated good knowledge regarding the GCS, while 52% exhibited poor knowledge. • 23.8% of nurses showed good clinical practice in GCS assessment, whereas 76.2% demonstrated poor practice. • 68.8% of participants reported low confidence in performing GCS assessment. • The most commonly identified barriers included excessive workload (96.5%), lack of continuous training (93.1%), lack of adequate knowledge and skills (88.1%), and lack of GCS assessment tools (78.7%). • Nurses working in intensive care units were more likely to demonstrate better knowledge compared to nurses in other departments. • Lower patient-to-nurse ratios were associated with improved knowledge and practice. • Positive correlations were identified between

nurses' knowledge and confidence levels. These findings indicate the importance of organizational support, staffing improvements, and continuing education programs to enhance nurses' competency in neurological assessment.

Conclusion

This study evaluated factors affecting critical care nurses' knowledge, practice, and self-confidence regarding Glasgow Coma Scale assessment in Saudi Arabia. The findings demonstrated significant deficiencies in nurses' practical application of the GCS and highlighted several organizational and educational barriers. The study emphasizes the need for regular educational programs, simulation-based training, and continuous professional development to improve nurses' competency and confidence in GCS assessment. Healthcare institutions should also address staffing shortages and workload issues to support effective neurological monitoring and patient safety. Improving nurses' proficiency in GCS assessment has important implications for patient outcomes, early identification of neurological deterioration, and quality of care in critical care settings. Future studies should include larger samples and evaluate the effectiveness of educational interventions in improving nurses' performance and confidence.

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Impact of Modified Objective Structured Clinical Examination Integrated with High-Fidelity-Simulation on Cardiopulmonary Resuscitation Competency among Newly Graduated Nurses

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Abstract

Cardiopulmonary resuscitation (CPR) is a critical procedure that greatly affects the survival rate of cardiac arrest patients. Since newly graduated nurses (NGNs) are often assigned to emergency care, they need to perform CPR effectively. However, there is still a gap between the theoretical knowledge and the practical readiness of NGNs to manage real emergencies. While the role of High-Fidelity Simulation (HFS) in bridging this gap is widely documented, its adoption within nursing education remains limited. A major area of concern is the continued utilization of traditional objective structured clinical examination (OSCE) to assess CPR performance. These evaluations often fail to capture the clinical decision-making process and the real-time stress of NGNs' CPR competence. Therefore, this study aims to investigate how integrating HFS with a modified OSCE checklist impacts CPR competency among NGNs. A systematic review was conducted across major health and education databases (e.g., PubMed, CINAHL, Embase, and ERIC), for the period of January 2019 to April 2025. Guided by the PRISMA framework, 15 peer-reviewed articles were selected from 60 records. Data synthesis involved an integrative thematic analysis using NVivo software. Themes focused on (1) transition from theory to practice challenges for NGNs, (2) the integration of HFS in CPR training and nursing education, (3) the relationship between HFS and improved CPR performance and (4) the OSCE tool. Findings indicate that during the transition to professional practice, NGNs face high stress, anxiety, and a lack of clinical confidence. The review highlights that HFS training significantly improves technical proficiency, such as compression depth, and non-technical skills like decision-making. Furthermore, traditional OSCE checklists were found to focus narrowly on procedural completion and binary scoring, whereas modified versions aligned with HFS provide a more valid and reliable assessment of CPR competencies.

Keywords: Cardiopulmonary Resuscitation competency, High-Fidelity Simulation, Newly Graduated Nurses, Objective Structured Clinical Examination, Simulation-based Learning

Introduction

Cardiopulmonary resuscitation (CPR) competency is a critical clinical skill that directly affects patient survival outcomes during cardiac arrest events. Newly graduated nurses (NGNs) are frequently the first responders in such emergencies, yet many enter clinical

practice with limited hands-on exposure to realistic resuscitation scenarios (Alharbi et al., 2023; Woodall, 2024). Recent nursing education literature has paid particular attention to the gap between theoretical instruction and the practical readiness of NGNs to perform effectively in real emergencies, and this gap has motivated the search for innovative training and assessment models.

Review of Related Literature

High-Fidelity Simulation (HFS) has emerged as a leading pedagogical strategy that bridges this theory–practice divide by providing immersive, realistic training environments in which learners can rehearse CPR safely (Cole et al., 2023; Herrero-Izquierdo et al., 2025). At the same time, the Objective Structured Clinical Examination (OSCE) remains the dominant tool for evaluating clinical performance. However, the traditional OSCE checklist has been criticised for focusing narrowly on procedural completion and overlooking essential non-technical skills such as critical thinking, prioritisation, communication, and adaptability (López-Herce et al., 2024; Purnajati et al., 2023).

Objectives

This paper systematically reviews and synthesises the recent evidence on the integration of HFS with a modified OSCE checklist for assessing CPR competency among NGNs. The objectives are: (i) to identify the transition challenges experienced by NGNs in performing CPR, (ii) to examine the adoption and educational role of HFS in CPR training, (iii) to assess the relationship between HFS and improved CPR performance, and (iv) to evaluate the strengths and limitations of OSCE as an assessment tool when integrated with HFS.

Methodology

Search Strategy

A systematic literature search was conducted from February 2025 to June 2025 using seven electronic databases: PubMed, CINAHL, Scopus, Web of Science, Embase, Cochrane Library, and ERIC. Grey literature was retrieved from ProQuest Dissertations and Theses, institutional repositories, ResearchGate, and Google Scholar. Boolean operators (AND, OR, NOT), truncation, and phrase searching were applied. The PubMed search string was: ("high-fidelity simulation" OR "HFS") AND ("cardiopulmonary resuscitation" OR "CPR") AND ("OSCE" OR "objective structured clinical examination") AND ("checklist" OR "modified checklist") AND ("newly graduated nurses" OR "novice nurses" OR "transition to practice").

Analysis

Inclusion and Exclusion Criteria

Studies were included if they (a) focused on the use of HFS in CPR training, (b) involved nursing interns, NGNs, or final-year undergraduate nursing students, (c) employed an OSCE assessment, particularly modified OSCE checklists, (d) were published between January 2019 and April 2025, (e) were peer-reviewed empirical studies, and (f) were published in English. Articles describing only low- or medium-fidelity simulation, studies focused on physicians or paramedics without nursing-specific data, editorials, opinion pieces, and studies lacking sufficient methodological detail were excluded.

Selection Process and Quality Appraisal

Screening followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) framework. An initial pool of 60 records was identified by title and abstract. After removing 30 duplicates and irrelevant titles and a further 8 records during full-text screening, 15 eligible articles were retained from database searches and supplemented with 19 grey-literature sources. Randomized controlled trials and qualitative studies were appraised using the Critical Appraisal Skills Programme (CASP, 2024) tools, and mixed-methods studies were appraised using the Mixed Methods Appraisal Tool (Hong et al., 2018). Quality was classified into three levels: high, medium, and low.

Data Extraction and Synthesis

Data were extracted manually using a Microsoft Excel matrix capturing study characteristics, methodology, sample, intervention, and outcomes. An integrative thematic analysis was performed using NVivo software (Lumivero, 2025) to code, categorise, and synthesise the qualitative and quantitative findings into unified thematic categories.

Findings and Discussion

The included studies represented diverse research designs (randomized controlled trials, quasi-experimental, qualitative, cross-sectional, scoping and systematic reviews, and meta-analyses) and were conducted in multiple countries, including Saudi Arabia, Spain, India, China, Jordan, Iran, Turkey, Palestine, Norway, Germany, and the United States. Sample sizes ranged from 15 participants to 1,987 trainees. Table 1 summarises the key features of the most relevant selected studies.

Table 1. Key features of selected studies on HFS, OSCE and CPR training (chronological order).

Author(s) & Year	Country	Design	Key Focus / Sample
Berger et al. (2019)	Germany	RCT	PBL with HFS in CPR (N = 54)
Roel & Bjørk (2020)	Norway	Quasi-Experimental	CPR competence intervention (N = 142)
Al Najjar (2020)	Saudi Arabia	Quasi-Experimental	Team-based learning with HFS (N = 81)
Hinduja et al. (2020)	India	Quasi-Experimental	HFS on CPR compression quality (N = 50)
Demirtas et al. (2021)	Turkey	Quasi-Experimental	Simulation-based CPR training (N = 89)
Ayed et al. (2021)	Palestine	Quasi-Experimental	HFS clinical decision-making (N = 150)
Azizi et al. (2022)	Iran	Quasi-Experimental	Simulation vs traditional method (N = 122)

Author(s) & Year	Country	Design	Key Focus / Sample
Al-Kalaldeh & Al-Olime (2022)	Jordan	Quasi-Experimental	ACLS self-efficacy through HFS (N = 70)
Guerrero et al. (2022)	Saudi Arabia	Quasi-Experimental	HFS exposure on OSCE (N = 192)
Al-Za'areer et al. (2023)	Saudi Arabia	Systematic Review	Simulation-based BLS/ACLS
Dubey & Mishra (2023)	India	Quasi-Experimental	OSCE-guided CPR instruction (N = 40)
Zeng et al. (2023)	China	Meta-Analysis	HFS efficacy in ALS (25 RCTs; N = 1,987)
López-Herce et al. (2024)	Spain	Quasi-Experimental	OSCE validity in pediatric CPR (N = 392)
Dharmarajlu et al. (2024)	Saudi Arabia	Quasi-Experimental	Pediatric CPR simulation (N = 75)
Herrero-Izquierdo et al. (2025)	Global	SR & Meta-Analysis	HFS in CPR (12 RCTs; N = 1,520)

Transition Challenges of Newly Graduated Nurses

Several studies reported that NGNs face anxiety, low confidence, and physical exhaustion during the transition from being students to professional nurses (Alharbi et al., 2023; Woodall, 2024). Roel and Bjørk (2020), in a quasi-experimental study with 142 nursing students, demonstrated that nurses' CPR capability is markedly weak in their first year of practice, particularly in adhering to current CPR guidelines. Amirtharaj et al. (2024) further argued that the heavy emphasis on theoretical learning leaves NGNs ill-prepared for real cardiac-arrest scenarios, supporting the need for technologically innovative training such as HFS.

Adoption and Role of High-Fidelity Simulation in CPR Training

Across the reviewed literature, HFS has emerged as a central pedagogical strategy in nursing and CPR education. Cole et al. (2023) reported a clear upward trend in HFS use for both teaching and assessment, while Al-Kalaldeh and Al-Olime (2022) showed that advanced manikins enable meaningful engagement with patient-safety and emergency scenarios. In Saudi Arabia, Al Najjar (2020) found that team-based learning integrated with HFS produced statistically significant gains in nursing-student competence ($p < 0.001$). In Iran, Azizi et al. (2022) reported that simulation-based teaching increased self-efficacy scores from 87.57 to 142.13 and performance ratings from 2.16 to 4.57. Ayed et al. (2021), in a pre-test/post-test study of 150 nursing students, similarly observed significant improvements in clinical decision-making, emotional regulation, and critical thinking among the HFS group, while Demirtas et al. (2021) and Berger et al. (2019) confirmed enhanced procedural competency and attitude toward practice. Despite these benefits, Fernández-Basanta et al. (2022) cautioned that simulation can heighten student anxiety, and Mulli et al. (2022) emphasised that experienced facilitators are essential for effective debriefing and reflection.

Relationship Between HFS and Improved CPR Performance

Empirical and meta-analytic evidence consistently links HFS to better CPR outcomes. Hinduja et al. (2020) demonstrated significant improvements in chest-compression depth among 50 emergency professionals after HFS training, and Rolston et al. (2020) reported similar gains in compression depth and psychological preparedness. Al-Za'areer et al. (2023) confirmed that HFS in nursing education enhances knowledge, technical proficiency, and decision-making during cardiac-arrest scenarios. The systematic review and meta-analysis by Herrero-Izquierdo et al. (2025) of twelve controlled trials with 1,520 participants endorsed HFS as a globally recognised CPR training method, while Zeng et al. (2023), in a meta-analysis of 25 RCTs (N = 1,987), reported significant improvements in advanced life-support knowledge retention and team communication. In Saudi Arabia, Dharmarajlu et al. (2024) found that nursing educators are increasingly incorporating simulation to deliver safe, competency-based pediatric CPR learning, although large-scale evaluations of long-term competence and patient outcomes remain limited.

OSCE as an Evaluative Tool for CPR Competence

OSCE is widely used to assess clinical competence and the outcomes of simulation-based learning. Guerrero et al. (2022) found that 192 nursing students exposed to HFS performed significantly better in OSCEs than peers receiving traditional instruction. Dubey and Mishra (2023) reported significant improvements in CPR performance after OSCE-guided training, although the absence of a control group and long-term retention measures limited interpretation. López-Herce et al. (2024) confirmed OSCE's validity in pediatric CPR assessment but flagged inter-rater variability as a major limitation. Purnajati et al. (2023) similarly criticised the binary nature of traditional OSCE checklists for failing to capture critical thinking, prioritisation, delegation, and adaptability in emergency CPR. Ha and Lim (2023) further noted that traditional OSCE settings can induce significant anxiety that impairs student performance, suggesting that, on its own, OSCE is not a holistic evaluative tool. Collectively, these findings support the use of modified OSCE checklists, designed in alignment with HFS scenarios, to enhance validity, reliability, and the comprehensive assessment of both technical and non-technical CPR skills.

Conclusion

This review highlights that NGNs continue to experience stress, low confidence, and a persistent theory–practice gap in performing CPR during real emergencies. High-Fidelity Simulation has gained strong international and regional recognition as an effective method for closing this gap by enhancing technical proficiency, critical thinking, confidence, and teamwork. While the traditional OSCE remains a valuable assessment tool, it tends to focus on procedural completion and is vulnerable to evaluator variability and learner anxiety. Modified OSCE checklists, when aligned with HFS, provide a more accurate, reliable, and comprehensive measurement of CPR competency, capturing both technical and non-technical skills. The synthesised evidence supports the development of a standardised, evidence-based educational model that integrates HFS with a modified OSCE checklist and underscores the need for empirical studies in the Saudi nursing-education context to evaluate its effect on CPR competency among NGNs.

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Evaluating the Effectiveness of Caregiver-led Asthma Management Programs among Preschool Children with Uncontrolled Asthma in Makkah: A Quasi-Experimental Study

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Abstract

Uncontrolled asthma remains a common problem among preschool children aged 3-5 years in Makkah, often resulting in repeated emergency visits and hospital admissions. This quasi-experimental pretest-posttest study, which includes intervention and control groups (120 caregivers in total, 60 in each group), aims to assess whether a caregiver-led asthma management program can improve symptom control among these children in Makkah, Saudi Arabia. Participants will be identified through the use of the Raqeem database of the Makkah Health Cluster's Primary Health Care Department and recruited using total population sampling from the Hadda center for the intervention group and the Alnawarryah center for the control group. Caregivers will complete a structured Knowledge and Practice Questionnaire, while children's asthma control will be measured at baseline; after the intervention using age-appropriate tools: the Childhood Asthma Control Test for children aged 4-5 years and the Test for Respiratory and Asthma Control in Kids for those aged 3-4 years. The intervention will consist of interactive sessions on asthma basics, trigger avoidance, correct medication use, symptom monitoring, and home management. The collected data will be analyzed using descriptive and inferential statistics, and is expected that better caregiver knowledge and practices will lead to improved child outcomes, lower symptom burden, and reduced healthcare use. This study is expected to provide useful evidence for family-centered asthma programs in primary care settings.

Keywords: Asthma, Caregiver Education, Makkah, Preschool Children, Primary Healthcare, Quasi-Experimental Study

Introduction

Asthma is a lifelong, non-infectious disease that impacts the respiratory system. It is characterized by airway inflammation and increased airway sensitivity. It is the most common chronic disease in children and young adults around the world. Asthma poses a major public health issue globally and is among the leading 20 conditions associated with morbidity and mortality worldwide (approximately 180,000 deaths per year) (Alansari & Mirza, 2020). Medical care alone cannot address the effects of asthma because of the substantial economic burden of healthcare costs, as well as social consequences stemming from job losses, children not attending school, and the psychological/physical stress on caregivers (Díaz, 2020; Tosca & Voigt, 2024).

There are still many asthma patients with poorly controlled asthma and recurrent exacerbations despite recent advances in the field of medicine (Pham et al., 2023). This demonstrates the inadequacy of medication in achieving asthma control and highlights the need for effective self-management strategies and caregiver involvement. In India, a randomized controlled trial on asthma education showed that discovery-based asthma education improved parental awareness and beliefs about asthma but did not produce significant changes in asthma control or severity (Divecha et al., 2020). Additionally, Sharma et al. (2021) conducted a quasi-experimental design pre-test/post-test study with parents/caregivers in Western India. Results showed that education materials for parents/caregivers improved knowledge and management practices; however, the clinical outcomes associated with caregiver education were still inconsistent across study participants.

Saudi Arabia also has a high prevalence of childhood asthma that is often poorly managed. In a study of children aged 4-11 years, Alhammad et al. (2020) found that 61.6% had poorly controlled asthma, as assessed by the C-ACT. One quarter of the caregivers surveyed reported receiving an asthma action plan, indicating a significant lack of education among caregivers (Wu et al., 2020). Children are at high risk for suffering from asthma due to many reasons; symptoms are often not specific; the diagnosis is sometimes ambiguous; caregivers are an important resource, and so much research on asthma excludes children, which makes management of children challenging. The research indicates that children under five years old have a particularly high degree of vulnerability in managing their asthma. It also demonstrates non-adherence to controller medications and an increased risk for exacerbations and hospitalizations for children ages four to six (Liu et al., 2024). The research illustrates that parental education can increase a caregiver's knowledge and attitudes about caring for a child with asthma; however, there is no correlation between improved scores on objective measures of asthma control, ICS adherence, or use of healthcare long-term for preschool children (Tang et al., 2024; Thach et al., 2024). This lack of correlation continues to create challenges for caregivers, such as ongoing debate over the optimal asthma medication regimen, particularly between combination controller-reliever medications and ICS monotherapy (Cicco et al., 2025). In Makkah, the number of asthma cases reported in 2022 is at its lowest level since reporting began in 2001. An estimated 9364 asthma cases were documented, which could be due to an underreporting of the number of asthma cases, and a lower number of people accessing health care services.

By comparison, asthma diagnoses and reporting increased dramatically in 2023, with 17887 cases documented. This could also be attributed to persons with asthma having greater access to medical services, increased awareness of asthma symptoms by family members or caregivers, improved diagnostic abilities, and/or increased exposure to environmental or lifestyle factors that result in an increased incidence of asthma. There are also unique characteristics of Makkah that may affect asthma outcomes for individuals living with asthma, such as high population density, overcrowding, caregivers using extended family members to provide daily assistance, and environmental factors. These unique characteristics underscore the need for asthma management programs tailored to the specific context.

Asthma detection and prevalence are on the rise in Makkah, as evidenced by the highest number of diagnosed asthma cases in 2024 at 2026. The reported increase in asthma may be due to a growing population, increased exposure to asthma triggers such as air

pollution, allergens, and/or irritants, or improvements in the identification of asthma IVTC cases through better healthcare services. This reported increase in asthma cases is much higher than the 2022 baseline; however, reports from 2025 indicate a drop in asthma cases to 15454. The decline in asthma cases may indicate that a trend has started due to the early-impact of improved asthma management resources (e.g., the Asthma and Allergy Foundation of America, or AAFA) as well as the existence of new public education campaigns regarding preventative health (e.g., SINA 2024), differences between the time periods selected for data collection, and missing data for the 2024 year, not to mention changes to DBA information through DHHS and other data sources.

The 2024 implementation of SINA's Asthma Guidelines aligns with much of this research, identifying the relationship between asthma, physician-patient relationships, shared decision-making, and individualized, well-structured self-management plans for the successful management of asthma in children. Parental-led asthma management through home-based asthma education aims to incorporate these same principles, specifically targeting children who do not yet manage their own asthma (i.e., those 4 years and younger), as they depend entirely on caregivers for daily asthma management.
The intervention enhances the continuity of care among healthcare providers and families by promoting the caregiver's knowledge related to the ongoing monitoring of asthma symptoms, the identification and avoidance of triggers, proper medication usage, and adherence to the prescribed treatment (Al-Harbi et al., 2024).

In addition, much of the research related to asthma in Saudi Arabia has focused on broader age ranges and/or longitudinal studies or reports about general caregiver knowledge about asthma rather than the evaluation of any specific parent-led interventions in a quasi-experimental (i.e., pretest-posttest) design specifically to parents/caregivers of preschool-aged children with asthma who live within the unique sociocultural and healthcare context of Makkah, Saudi Arabia. This lack of research evaluating the effectiveness of empowering parents/caregivers to assume primary responsibility for their child's asthma control and management practices and related health outcomes leaves unanswered the question of whether this will improve asthma control, management, and outcomes for preschool-aged children.

Accordingly, this quasi-experimental study will evaluate the effectiveness of a parent-led asthma management program for preschool-aged children with uncontrolled asthma in Makkah, Saudi Arabia, through the examination of changes in symptoms of asthma, caregiver knowledge of asthma management, and caregiver practices for asthma management, the number of healthcare visits related to asthma, and quality of life relative to asthma in preschool-aged children with uncontrolled asthma.

Review of Related Literature

Overview of Asthma in Pre-school age in Saudi Arabia

Asthma is still an important global health issue, and it has become an increasingly significant health issue for children in Saudi Arabia (see Taherian et al., 2023). Young children (particularly those aged less than five) are at high risk of developing respiratory illness because developmental factors directly affect the structure of the airways and the immune response (Zhou & Tang, 2025). So there are serious clinical, public health, and scientific implications related to the increasing incidence of asthma among children in Saudi Arabia.

Also, the number of patients with asthma seeking healthcare has increased. Asthma is one of the top reasons people visit their primary care providers in Saudi Arabia and the number one reason for avoidable hospitalization (Alharbi et al., 2022). In addition to the increase in patients accessing the hospital system for asthma during the height of the respiratory virus season, asthma also places a drain on the hospital system and strains hospital services (Alatawi & Alanazi, 2020). The costs incurred by hospitals due to asthma exacerbations and hospital admissions clearly demonstrate that the current strategies for managing asthma are ineffective or insufficient (Alatawi & Alanazi, 2020).

Caregiver-Initiated Asthma Education Program

Caring for and educating about childhood asthma has been the focus of many studies over time. The evidence demonstrates a strong association between caregivers' participation in asthma management and successful outcomes for children (Alotaibi et al., 2021; Smith & Brown, 2022). Many studies have established that educational programs delivered by parents improve youth asthma symptoms, reduce the frequency of emergency department visits, and increase adherence to therapy among young children. There are several structured, caregiver-directed asthma education programs in Saudi Arabia, implemented through the primary health care (PHC) and school systems and through governmental agencies such as the Saudi Initiative for Asthma (SINA). These programs teach caregivers how to effectively manage asthma, including avoiding triggers, using their medication appropriately, and developing action plans, but do so in such a manner as to assume that if the caregiver understands asthma, they will be able to manage asthma at home successfully.

The positive findings of a recent randomized trial by Khan et al. (2023) reinforce that when caregivers are given a structured caregiver training program, they are more confident in monitoring their children's asthma at home. Collectively, the above references highlight that promoting caregiver empowerment is an essential element for achieving optimal asthma management in young children.

Effectiveness of Caregiver-Directed Asthma Management Programs

As several experts have noted, asthma is difficult to manage. Over time, the literature has demonstrated that despite advances in pharmacotherapy (Hynes et al., 2019; Cujilema et al., 2024), children continue to develop new limitations due to asthma. Everhart et al. (2020) have shown that differences in functional ability related to asthma, as well as additional economic and cultural factors within the family, explain why children have higher-than-expected asthma morbidity and healthcare utilization.

Finally, asthma in young children can negatively interfere with day-to-day function and children's quality of life. Kamp et al. (2023) illustrate that an effective parent-led program for the management of this condition has the greatest impact on improving health status while reducing the burden of care on the family. The use of appropriate asthma medications, combined with caregiver-directed management strategies, can help control symptoms and improve quality of life for both children and their families (Dardouri et al., 2022; Mendes et al., 2024).

Effectiveness of Caregivers/Parents Knowledge on Management of Asthma

Caregiver knowledge, attitude, and practice have long been established as determinants of a child's asthma status. It has been demonstrated in numerous studies, that when a

parent understands the identified triggers for asthma, consistently ensures that the child's medications are being taken properly (adherence), and has an action plan, the child's symptoms are effectively controlled and there are fewer exacerbations (the child's quality of life will improve) (Shaheen et al., 2025; Alsayed et al., 2023). Caregivers' low adherence to their child's treatment and/or poor asthma control has been identified as being related to a lack of knowledge regarding asthma management and medication use (Tang et al., 2024). Developing a comprehensive education and empowerment program for caregivers will benefit both caregivers and children with asthma. If the caregiver knows asthma pathophysiology, triggers, and management, the child will experience improved disease control (Com et al., 2022; Cujilema et al., 2024). According to the study by Alhazmi et al. (2022), Asthma control was measured in a large-scale, cross-sectional study of the education program and flu vaccine among children with asthma (bronchial asthma) at six primary health centers in Madinah, Saudi Arabia. Researchers analyzed data from 804 asthmatic children using valid tools: the (C-ACT) Childhood Asthma Control Test for children aged 5–12 years and the TRACK tool for children aged <5 years. Data collected from both tools showed that school education and flu vaccination had a significantly positive impact on asthma outcomes for children in the education program. Post-education children showed reduced ED visits, hospital admissions, and PICU admissions compared with pre-education children. With regard to asthma control, post-education children had higher C-ACT scores and TRACK scores, and a higher percentage of children had their asthma controlled.

Additionally, children who received the flu vaccine had lower rates of ED visits and hospital admissions for asthma. The authors state that in children with asthma, the combination of an organized asthma education program and receipt of the flu vaccine has a positive effect on asthma control and on decreased health service utilization rates. However, the authors feel that longitudinal and experimental studies are needed to validate these results.

Pediatric Asthma Quasi-Experimental Studies in Saudi Arabia and Other Countries

Pediatric asthma continues to be a public health issue in Saudi Arabia, where the increasing prevalence and high rate of exacerbations place a heavy burden on families and the healthcare system. In Saudi Arabia, researchers mostly use quasi-experimental designs to evaluate educational and behavioral interventions that educate caregivers about their roles in knowledge creation and in improving the asthma symptoms and treatment of children with asthma. Researchers have found in other areas of the world (Asia, the Middle East, etc.) that quasi-experimental studies have consistently shown that asthma education, caregiver training, written action plans, and ongoing support result in reductions in emergency department visits and improved use of asthma medications (by either children or their caregivers) and asthma disease management. Current studies from Saudi Arabia are consistent with international research showing that culturally relevant community-based pediatric asthma programs improve clinical outcomes. This accumulation of international and local quasi-experimental research studies provides evidence to support that well-planned, context-appropriate asthma programs reduce asthma morbidity and support long-term control for children with asthma.

Overall, an extensive body of literature supports the notion that supporting caregivers through culturally sensitive asthma programs can improve asthma outcomes for preschool children. However, there is a significant gap in quasi-experimental research targeting preschool children with uncontrolled asthma in Saudi Arabia. This study addresses this

gap by evaluating the outcomes of a caregiver-on-lead asthma program using a quasi-experimental pre-test/post-test control-group design, thereby providing context-specific data to organizations working in this area and aiding in the development of new programs and policy recommendations.

Objectives

The purpose of this study is to evaluate the effectiveness of a caregiver-led asthma management program on asthma symptom management in preschool children with uncontrolled asthma residing in Makkah, Saudi Arabia. Using a quasi-experimental pre-test/post-test design and consisting of an intervention group and control group, the purpose of this study is to evaluate if an evidence-based, culturally appropriate educational program that empowers caregivers can translate into self-management (i.e., amount and frequency of prescribed asthma medications), reduced overall asthma symptoms, and improved clinical outcomes (i.e., frequency of medical appointments, medication compliance).

The specific research questions of the study are as follows.

1. What is the level of knowledge and practices of caregivers/parents regarding asthma management in the intervention and control groups before and after the implementation of the caregiver-led asthma management program?
2. What is the level of asthma symptom control of the children, as reported by caregivers, in the intervention group and the control group before and after the implementation of the caregiver-led asthma management program?
3. Is there a significant difference in the level of asthma symptom control between the intervention group and the control group from pretest to posttest?
4. What is the magnitude of change of the caregiver-led asthma management program on asthma symptom control compared with the control group from pretest to posttest?
5. Which components of the caregiver-led asthma management program are most strongly associated with improved asthma symptom control in the intervention group compared to the control group?

Methodology

Research Design

A quasi-experimental research design enables the researchers to determine the efficacy of an intervention on a known outcome when random assignment of subjects to intervention (experimental) and control groups is not feasible. Quasi-experimental designs may be beneficial in real-world settings when randomization is impractical or unethical, yet the researchers still want to assess links between variables (Thomas, 2024Therefore, this investigation will utilize a quasi-experimental design with a non-equivalent control group. Researchers can compare groups while accounting for the ethical and practical constraints of healthcare settings. There will be two groups of caregivers in this study: one will receive caregiver-led asthma management program interventions (the experimental group). At the same time, the other will continue to receive standard caregiving services (the control group). Both groups will have their levels of caregiver knowledge, caregiver behaviours, and child asthma control assessed before the study and again after the study concludes.

By comparing pre- and post-intervention scores across both groups, the researchers can determine program efficacy by controlling the factors such as seasonal variations and environmental triggers that may affect the variables of this study.

Participants

According to data collected from Hadda's Primary Health Care Center, where the intervention will take place, 60 preschool-age children aged 3-5 years have been diagnosed with uncontrolled asthma, have all their medical records on file (current), and are being treated accordingly. In the last quarter of 2025, the center's health information system indicated that 60 cases were confirmed as having uncontrolled asthma. In addition to the Hadda Center, Alnawarryah's Primary Health Care Center — designated as the control group — has reported an average number of 57 preschool-age children diagnosed with uncontrolled asthma. The average number of cases may vary; thus, the 57 currently diagnosed will continue until they reach 60, and the total number of participants will be equal in both experimental and control groups.

Caregivers associated with both intervention sites were limited by the low number of preschool-age children (3-5 years) diagnosed with uncontrolled asthma; therefore, 60 caregivers from the intervention site will represent participants, and 60 caregivers from the control site(s) will as well. A census sampling method will be used for both groups. All eligible participants from the Makkah Health Cluster who meet the inclusion criteria will participate, thereby increasing the study's statistical power while creating a comprehensive sample of the target population to enhance the effectiveness of this quasi-experimental study. Furthermore, equal sample sizes in both groups will reduce the likelihood of bias and improve the validity of the results by creating comparable groups that enable more accurate statistical analyses when evaluating the effectiveness of the caregiver-management program. Inclusion criteria include: 1) Caregiver to children ages 3-5 years of age; 2) Children have been diagnosed by their pediatricians as having asthma; and regularly visit their medical home consistently; 3) Caregivers are willing to participate in the caregiver-led asthma management program; and 4) Caregivers speak Arabic and have a sufficient level of understanding to be able to participate effectively. Inclusion criteria ensure that caregivers who meet these criteria are suitable candidates to receive the intervention and are therefore able to participate fully in the caregiver-led interventions.

Instrumentation and Data Collection

To evaluate whether the Asthma Management Program improved preschool children's asthma symptoms and to assess caregivers' asthma knowledge and participation, the researchers will collect quantitative data on caregivers' knowledge and participation using self-administered questionnaires. Caregivers' asthma knowledge and practice will be measured using two main instruments: the Caregiver Knowledge and Practice Questionnaire and the Childhood Asthma Control Test (C-ACT or TRACK) modified for Saudi Arabia. The questionnaire utilized to collect this data will also include some demographic information about both participants (the child and the caregiver). The significance of this demographic information will be threefold: it will be used to describe the sample for statistical purposes, to identify possible confounding variables, and, if necessary, to conduct subgroup analyses.

The Caregiver Knowledge and Practice Questionnaire will facilitate the assessment of caregiver knowledge regarding asthma, medications, triggers, symptoms, and daily

management practices. Before caregiver-led program implementation, the researchers will administer a pre-program knowledge assessment (to all participants) along with a post-program knowledge assessment (to all participants) to determine whether or not any change has occurred. Caregiver knowledge will be assessed based on participants' responses to closed-ended questions, either true or false. There may also be questions regarding how frequently caregivers have followed the recommended practices, and participants will respond to these questions using a 4-point Likert Scale (4- Always, 3- Often, 2- Occasionally, and 1- Never). The same assessment tool will be used for both the intervention and control groups.

In addition to assessing caregivers' knowledge of asthma and its control in childhood, the researchers will use valid, age-appropriate measurement tools to assess asthma control in the study. Specifically, for children aged 3-5, the researchers will utilize the Childhood Asthma Control Test (C-ACT). For children younger than 5 who are unable to self-report accurately, the investigator will utilize the Test for Respiratory and Asthma Control in Kids (TRACK). Recently published data from the International Journal of Pediatrics could be helpful for the investigator when measuring asthma-related morbidity. There are two different assessments: the C-ACT scores 0-27, and a score of 19 or less indicates poor asthma control, with frequent unwanted events. The TRACK assessment has a higher score (0-100), so a score below 80 indicates uncontrolled asthma. Both the C-ACT and TRACK are well-known, validated tools; therefore, both assessments should provide very accurate and reliable data. In this study, caregivers who are already administering either the C-ACT or TRACK will assess their child's asthma symptoms pre- and post-intervention (parent-led asthma control plan) for any change in symptom severity and/or functional status. The comparison of baseline and post-intervention will provide an objective measure of the improvement of asthma control and thus assess how effective the caregiver-led intervention program has been at controlling or limiting asthma symptoms in preschoolers.

Content Validity and Reliability

To establish the validity of the questionnaire tools used in this study, the content will be reviewed by experts for the Caregiver Knowledge and Practice Questionnaire and the childhood asthma control/management (C-ACT)/TRACK. This review will be conducted by a multidisciplinary expert panel (a pediatric nurse specialist, a pediatric pulmonologist/asthma specialist, a family physician consultant with experience in chronic disease management, and a public health expert with experience developing questionnaires). Through their analysis, the investigators will be able to determine whether the measured items accurately reflect the constructs of candidates' typical responses and whether their knowledge of asthma management practices for children is adequate.

To assess the reliability of the instruments, a pilot study will be conducted with caregivers who are eligible to participate (but not included in the actual study). The pre-test will assess the internal consistency and stability (reliability) of the instrumental assessments. The internal consistency reliability (reliability) of the caregiver's knowledge/practice and/or assessment instruments will be calculated using Cronbach's alpha (i.e., a statistical measure of reliability). A Cronbach's alpha value of at least 0.70 is considered to be acceptable.

In addition, the psychometric properties of the C-ACT and TRACK instruments from previous studies support the reliability. This will also be assessed for local adaptation. When the reliability and validity of the collected data are ensured, the data or information will be deemed consistent and accurate and, therefore, suitable for evaluating the familial or parental-led asthma management program.

Because the sample participants will be predominantly Arabic-speaking, the questionnaires will require forward and backward translation. That is, two independent translators will independently produce two different Arabic-language versions of the questionnaire. One translator and the researchers will perform a back-translation of the final Arabic version into English to ensure that the final back-translated version is semantically and conceptually consistent with the original English version. The Arabic-language version of the final research report will be pre-tested to ensure clarity, cultural appropriateness, and understanding, thereby validating and ensuring the reliability of the research instrument.

Data Collection Methods

Data collection will be systematic and organized. There are 3 phases in the study — Phase 1: Pre-intervention assessment; Phase 2: Implementation of a caregiver-led asthma management program; and Phase 3: Post-intervention assessment for the treatment group. To assess caregivers' baseline knowledge and practice regarding asthma before participating in the entire study, candidates will be identified from the Raqeem database of the Makkah Health Sector, Primary Health Department. After being identified, potential participants will be asked to complete a Caregiver Knowledge and Practice Questionnaire regarding their understanding and management of asthma. The Childhood Asthma Control Test (C-ACT) will be used to assess how well children are managing their asthma before participating in the study. Both of these measurements will help establish the typical level of asthma control prior to study participation.

The intervention will consist of educational sessions designed to provide caregivers with the knowledge and skills to manage their child's asthma. Educated caregivers will become knowledgeable about asthma, recognize and avoid triggers, use medications properly, monitor symptoms (with family members' cooperation), and provide culturally sensitive education.

Caregivers will complete the Caregiver Knowledge and Practice Questionnaire and the C-ACT after completing the caregiver-led asthma management intervention. This study aims to determine whether a caregiver-oriented intervention has improved knowledge and practice in asthma management among caregivers of children with asthma.

The control group will utilize a traditional approach to asthma management through their primary health care provider. This involves a typical medical consultation, general education, and general advice on asthma management from a health care professional, delivering the regular asthma services as per usual, without participation in the caregiver-oriented asthma management program.

The control group will undergo a traditional approach to asthma management with their primary health care provider. This involves a typical medical consultation, general education, and general advice from a health care professional on asthma management - delivering the usual asthma services as per normal, without attending an organized caregiver-oriented asthma management program.

A pre-/post-test method will be used for data collection. At the beginning of the study, caregivers will complete the "Caregiver Knowledge & Practice Questionnaire," and the "Child Asthma Control Test" (C-ACT) will be administered to determine the level of asthma control for the children. Data will be collected at the end of the intervention using the same tools as at the start. The objective is to compare the level of improvement in knowledge and practices resulting from a caregiver-led asthma management program with the usual practice of asthma management through their primary health care provider. Data will be collected, labeled, and maintained safely and confidentially.

Pursued in an orderly manner, implementing an established systematic approach can ensure that the data are reliable, complete, and suitable for the quantitative statistical analysis required to meet research objectives and test the hypotheses developed by the investigator in this study.

Analysis

The data analysis for this study will be based on both descriptive and inferential statistics, as modified for use with the quasi-experimental pre-test–post-test control-group design. Descriptive statistics (mean, standard deviation, frequency, and percentage) will be used to summarize the pre-test and post-test asthma symptom control scores of participating children in the intervention and the control groups. The pre-test and post-test scores can then be used to compare asthma control levels across groups and to provide objective documentation of each group's demographic and baseline characteristics and post-intervention outcomes.

To assess whether a statistically significant difference exists in asthma symptom control between the intervention and control groups from pre-test to post-test, inferential statistics will be employed. For this study, gain scores (post-test score minus pre-test score) will be evaluated using independent-samples t-tests. If the homogeneity-of-variance and normality assumptions are violated, the Mann-Whitney U test will be used as a nonparametric alternative to the independent-samples t-test.

Effect size analysis will be conducted on the mean change gain scores of the two groups (i.e., the intervention group versus the control group) using Cohen's d to illustrate the magnitude of change and the practical significance of the caregiver-led asthma management program. This will provide an estimate of the intervention's effect size (large, medium, or small).

Using multiple linear regression analysis, the final component of this analysis will identify the major factors in the caregiver-led asthma management program related to better asthma symptom control. The dependent variable will be the post-test asthma control score; the independent variables will be the pre-test asthma control score, group, caregiver knowledge, medication adherence, trigger avoidance, and symptom monitoring. This will enable evaluation of how much specific components of the intervention contributed to improvements in asthma symptom control, while statistically controlling for baseline differences between groups.

Findings and Discussion

Anticipated Findings

This study is expected to demonstrate that the caregiver-led asthma management program will notably improve caregiver knowledge, management practices, and asthma outcomes among preschool children with uncontrolled asthma in Makkah. Caregivers in the intervention group are estimated to show improved understanding of asthma triggers, correct medication use, symptom monitoring, and adherence to asthma management plans compared to those receiving usual care.

Children in the intervention group are likewise expected to exhibit significantly improved asthma control scores (C-ACT and TRACK) from pre-test to post-test, with a greater proportion achieving controlled asthma status than those in the control group. The findings are also expected to reveal statistically significant differences in gain scores between groups, supporting the effectiveness of the intervention program.

The intervention is anticipated to produce meaningful clinical improvement, reflected in better symptom control and reduced asthma-related healthcare utilization, including emergency visits and hospital admissions. Caregiver knowledge, medication adherence, trigger avoidance, and symptom monitoring are expected to emerge as important predictors of improved asthma outcomes.

Conclusion

This study aims to demonstrate that a caregiver-led asthma management program is effective in improving asthma control among preschool children in Makkah. The overall goal is to enhance caregivers' knowledge and facilitate better symptom management, leading to improved children's health outcomes. Based on this research, it is anticipated that identifying the caregiver's pivotal role in managing asthma in children will provide a rationale for implementing culturally relevant, family-centered programs in primary care. These culturally relevant, family-centered programs may empower caregivers, reduce asthma-related complications, and improve families' overall health. Collectively, the results will support the implementation of culturally relevant, family-centered programs in the primary care setting to improve asthma control in children. This may help improve children's asthma control, empower the caregivers, and create a healthier family. This may support the evaluation of caregiver-led asthma management programs as a key intervention to improve asthma control in preschool-aged children in Makkah.

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The Impact of Nurse-led Interventions on Patient Outcomes

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Abstract

Nurse-led interventions help to enhance self-administration proficiency and enhance their quality of life, which is advantageous for facilitating health outcomes and curing diseases in primary health institutions in China. Nevertheless, there is still a deficiency of awareness and understanding about the importance of nurse-directed intervention approaches to improve patient health outcomes. Therefore, the current research sought to examine the implications of nurse-guided intervention strategies in enhancing possible patient healthcare outcomes. The current research used a cross-sectional, quantitative research design to gather primary data in a particular time structure. The study employed a survey method by distributing structured questionnaires to the selected participants and collecting data from those respondents. This study utilised the purposive sampling technique to select 778 nurses from primary hospitals in Beijing, China. The researchers employed descriptive analysis to define the essential elements of data, while the connection between nurse-directed intervention approaches and health outcomes of patients was examined by employing Analysis of Variance (ANOVA). The primary results of the research indicated that nursing care strategies impacted the advancement of patient outcomes by early detection of complications and ensuring consistent monitoring. The research also highlighted that nurse-directed interventions played a significant part in patient outcomes, through qualification of nurses and nurse-patient interaction. In conclusion, it can be indicated that adequate knowledge about efficient nurse-driven intervention strategies in improving patient outcomes is essential to minimise the frequency of hospital visits. Furthermore, the study concluded that effective nurse-led intervention techniques help in supporting modifications to a healthy lifestyle, such as an appropriate dietary plan and exercise, eventually facilitating patient health outcomes.

Keywords: Ethical Standards, Nurse-Led Interventions, Nurse-Patient Communication, Nurse Qualification, Patient Outcomes

Introduction

According to the A nurse-led intervention can be defined as the approach of delivering healthcare in which an expert nurse manages planning, leading, and maintaining a vision on different aspects of providing caregiving and treating patients. Nurse-led interventions can transpire in a spectrum of healthcare institutions, including clinics, healthcare establishments such as hospitals, community health centres and even patients' residences. Nurse-led self-administration initiatives have evolved as an advantageous approach, highlighting patient knowledge and the active involvement of nurses in providing care services (McParland et al., 2022). A previous research of Berardinelli et al. (2024) demonstrated that nursing care strategies play an important function in increasing

medication compliance among patients suffering from chronic diseases. This also found that personalised knowledge, proper counselling, and adequate behavioural assistance provided by expert nurses invariably led to more satisfactory allegiance outcomes, corresponding to standard healthcare services. In addition, the employment of multidisciplinary practices, where qualified nurses cooperate with expert physicians and additional healthcare professionals, further reinforces adherence results (Berardinelli et al., 2024). Patient outcomes are the measurement of the efficacy and the rate of success of healthcare services and required interventions. As mentioned by Bhati et al. (2023), patient health outcomes encompass a broad range of characteristics, which include health and patient well-being, care satisfaction, speedy recovery, and treatment-condition-specific adverse event prevention. Enhancing health outcomes of patients is an ethical imperative and a crucial element of providing quality healthcare and evaluation of performance. The research findings indicated that clinics and other healthcare organisations are constantly functioning to improve patient healthcare outcomes. Improved health outcomes acknowledge that they are inherently associated with the prominence and success rate of the healthcare organisation (Bhati et al., 2023).

There are several influencing factors of nurse-led interventions that directly impact the overall healthcare outcomes among patients. The qualification of nurses is an important element in improving overall patient outcomes, as higher nurse qualifications are strongly related to better patient outcomes. Skilled and competent nurses are additionally qualified for early detection of patient complications, lowering errors of medication, and enhancing rates of patient recovery. In addition, nurse-patient communication has a substantial influence on the overall patient outcomes, as adequate communication approaches enhance acquaintance, belief, and association between patients and nurses. Adequate communication between patients and nurses additionally improves patient safety by decreasing misinterpretations and indecisiveness in treatment procedures and eventually promotes patient-centred healthcare outcomes (Lukewich et al., 2022). Similarly, interprofessional collaboration is regarded as another important factor that improves patient outcomes by encouraging interaction and teamwork between nursing staff and other healthcare specialists, which renders patient-centred care more integrated, reliable, and productive. Strong interprofessional cooperation greatly contributes to higher-quality services to the patients and effective patient outcomes by improving patient satisfaction. Consequently, ethical standards have a substantial effect on comprehensive patient health outcomes as the guidelines recommend professionals in healthcare institutions to provide secure, compliant, unbiased, and patient-centred healthcare services. Additionally, ethical practices encourage honesty, propriety, and regard for patient privileges and refinement, which boosts trust among patients and nurses (Kaiser et al., 2022).

Review of Related Literature

Nurse-led interventions are considered effective healthcare approaches designed and operated by skilled nurses to enhance patient health, well-being, and comprehensive quality of care services. According to Qiu (2024), expert nurses help patients with existing diseases, observing treatment strategies, and embracing healthy behavioural patterns. Skilled nursing professionals also monitor the health progress of patients and help in the early detection of health-related risk factors. The results revealed that nurse-led care services increase the relationship between provided healthcare services and ensure consistency of treatment for patients. In addition, patients usually feel more satisfied discussing health-related situations with nurses, which boosts belief and healthcare experiences and eventually improves potential patient healthcare outcomes. In

the settings of critical care, nurse-led intervention approaches assist in timely decision-making aspects and maintenance of patient safety (Qiu, 2024). Additionally, another prior research of Ruksakulpiwat et al. (2025) identified that care interventions provided by nurses have attained significant attention as an advantageous strategy to improve the standard of delivery of healthcare services for patients with multimorbidity. The interventions provided by nurses are often represented in progressive approaches or professional functions, considering the primary obligation for coordination of care services, healthcare education, counselling related to lifestyle changes, and administration of symptoms. The resilience of nurse-guided measures relies on their patient-focused philosophical approaches, which significantly parallel the requirements of individuals with factors of multimorbidity. Further, nursing professionals are exceptionally positioned to deliver consistency of care services, facilitate patient autonomy, and assist self-administration through recurring communication and authorised curative connections (Ruksakulpiwat et al., 2025).

There are some influencing factors associated with nurse-led interventions that directly or indirectly influence patient outcomes. The qualification of nurses is considered one of the most influential elements that impact the comprehensive healthcare outcomes of patients. A study by Dall'Ora et al. (2022) has investigated that the effective expertise of nurses delivers more satisfactory monitoring of patients, appropriate documentation of patient information, and effective collaboration with healthcare teams to provide better healthcare outcomes to the patients. The study findings indicated that increased levels of skilled registered nurses were related to reduced mortality rates of patients, lower unfavourable incidents, and more satisfactory patients' health-related safety outcomes. In addition, in primary healthcare settings, nurses who are both qualified and registered facilitated appropriate management of chronic diseases, improved satisfaction among patients, and delivery of premium quality healthcare services (Dall'Ora et al., 2022).

Communication is considered a prior characteristic in the development of the nurse-patient connection and comprises the techniques used to treat patients and the outcomes of their care service planning. According to Alshalawi et al. (2025), communication is considered one of the most crucial elements of providing patient care as it constructs a favourable and health-focused environment between patients and nurses. The study discovered that sufficient nurse–patient communication boosted satisfaction among patients, improved trust, emotional assistance, and the overall quality of care provided. Consequently, effective communication between patient and nurse also lowered anxiety and stress levels of patients and improved healthcare experiences. Additionally, the quality of communication approaches facilitated patient-centred health outcomes, self-administration, understanding of treatment strategies, and decision-making among patients (Alshalawi et al., 2025).

Interprofessional collaboration is another important factor in the context of providing quality care services to patients, as the approach creates required coordination among healthcare professionals, which improves patient healthcare outcomes. Prior research conducted by Bouton et al. (2023) determined that active interprofessional collaboration directly impacted satisfaction among patients and the overall healthcare outcomes of patients. Additionally, collaborative teams in healthcare settings helped the appropriate administration of chronic diseases and ensured patient safety and accessibility of healthcare services. The study findings indicated that effective interprofessional collaboration favourably affected patient-focused outcomes, which included patient

satisfaction, increased trust in care services and quality of communication approaches. In addition, the results revealed that interprofessional understanding and teamwork among healthcare specialists lowered patients' rates of mortality and boosted patient health-focused safety outcomes (Bouton et al., 2023).

Ethical standards play an essential function in healthcare settings and have a substantial influence on patient healthcare outcomes. Ethical norms are considered the honourable regulations and professional policies that lead healthcare professionals to deliver secure, compliant, genuine, and appropriate care services to patients. Prior research by Cruz Rivera et al. (2022) identified that nurses often experience moral dilemmas, leading nurses in navigating intricate alternatives between conflicting directions. However, the study reported that moral nursing practice helped in the appropriate maintenance of patient safety, regard for patient independence, build trust, and more satisfactory nurse-patient connections. The findings of the study indicated that ethical health specialists involve patients in decision-making and respect their choices, opinions, and values. In addition, through informed approval, patients acquire thorough details about their treatment procedures, advantages, and potential risks, which in turn boosts patient satisfaction and acquires the required cooperation for treatment (Cruz Rivera et al., 2022). Watson's Theory of Human Caring is considered an appropriate theory to describe nurse-led interventions implemented to emphasise the supply of patient-centred and empathetic care services for patients and enhance patient healthcare outcomes. The theory was developed to highlight the significance of care service associations in effective nurse-directed practices. According to Watson (1979), the theory explained that nursing practice not only concentrates on treating sickness but also on fostering recovery through empathy, consideration, and emotional assistance. The theory also acknowledged that providing care is the establishment of nurse-directed practices and assists patients in achieving more satisfactory physical and psychological well-being. According to the theory, a healthy nurse-patient relationship within the healthcare settings adequately enhances appropriate patient satisfaction and speedy recovery. In addition, maintenance of effective communication, improved empathy, and sincere care help patients feel respected and assisted during the period of treatment. The distinct theory also underlined acquiring self-directed care approaches for nursing professionals, considering that providing care enhances the capacity to deliver care services for others (Watson, 1979). Several studies have used the mentioned theory to establish the significance of effective nurse-guided practices in providing patient-focused healthcare assistance. Previous research by Gunawan et al. (2022) aimed to highlight the way the respective theory can be implemented in nursing management and leadership approaches. The distinct research concentrated on incorporating appropriate care service regulations into nursing administration, favourable healthcare systems, and patient care approaches to improve healthcare outcomes among patients. The findings of this study demonstrated that the respective theory enhanced empathetic nursing care services, maintaining effective communication and relationships among patients and nurses. The study determined that implementing the mentioned theory in maintaining nurse-led interventions can facilitate high-quality healthcare services, improve patient satisfaction, and comprehensive patient health outcomes by supplying empathetic nursing care (Gunawan et al., 2022). In summary, the discussion demonstrated that nurse-led interventions based on the mentioned theory improved satisfaction and recovery rates of patients, fostered patient-focused care services, and strengthened nurse-patient relationships.

Objective

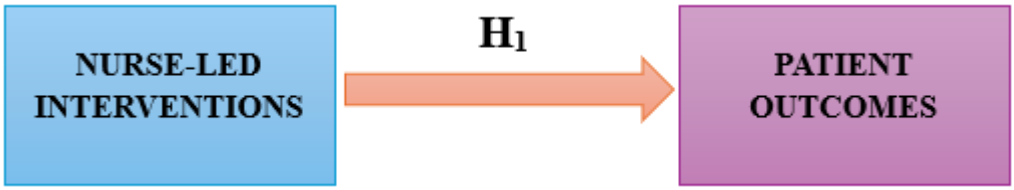
- To evaluate the influence of nurse-led interventions on patient outcomes.

Methodology

Research Design and Procedure

A quantitative, cross-sectional study design was used in the current research to evaluate the influence of nurse-directed intervention approaches on comprehensive health outcomes of patients. The specific study design highlighted the practical collection of numerical data from nurses from primary hospitals in Beijing, China, within a distinctive time frame. The design also estimated intricacies while assessing the relationship among identified research variables. The collection of quantitative data was conducted through the allocation of both online and offline structured questionnaires to the selected study participants. The present study approach included the development of tools associated with the survey based on identified research variables and related factors. A pilot test confirmed the validity of the collected data, while Cronbach's Alpha was employed for the proper estimation of reliability. Correspondingly, satisfactory distribution of the structured survey questionnaire to the selected study respondents, along with appropriate statistical analysis by using SPSS 25, helped to demonstrate a quantifiable association between nurse-directed interventions and probable patient outcomes. The direct principles and size of the statistical connection were indicated employing a confidence interval at 95%. The statistical significance threshold had been set at a p-value < 0.05. The researcher employed the descriptive analysis method to determine the important elements of the collected quantitative data, while the collected data was assessed using the ANOVA approach.

Operational Framework



Subjects or Data Sources

A survey approach was utilised to collect primary data to complete the present study. The study participants were primary hospital nurses in Beijing, China, from whom the primary information for the research was collected. There were two different parts to the survey: (a) information concerning demographic data of the chosen research participants, and (b) a 5-point Likert scale with questions concerning the influence of nurse-directed intervention strategies on patient health outcomes.

Analysis

Instrumentation and Data Analysis

The present research used a purposive sampling technique to select valid and relevant study respondents in the research context. Raosoft tool recommended the optimal sample size of 713 for the data collection for the study. Therefore, 850 survey questionnaires were distributed to the respondents. Research participants returned 823 questionnaires to the researchers, from which 45 questionnaires were discarded because of inappropriate or incomplete responses. Henceforth, the final sample size was 778. Microsoft Excel and SPSS version 25 were utilised for performing statistical analysis for the research study. The

researcher employed a descriptive analysis technique to understand the essential elements of the gathered data, while ANOVA was used to assist in evaluating the data collected.

Limitations

The present research study encountered different limitations, specifically intrinsic in quantitative research. The employment of closed-ended survey questionnaires limited research participants from providing thorough interpretations, which restricted the ability to summarise different perspectives or contextual components influencing their views regarding nurse-guided interventions and patient outcomes. Quantitative data oversimplified the effect of effective nurse-guided intervention approaches on probable healthcare outcomes among patients. In addition to this, data collection from only primary hospitals in Beijing, China, developed issues related to the appropriate representation of more comprehensive findings on the selected study topic. The cross-sectional research design restricted the study's capability to develop causality, as the quantitative data revealed relationships at a particular time frame rather than transformations over a period. Finally, the results of the current research study were not completely generalisable beyond the target population, as the findings were influenced by additional demographic characteristics and communication strategy exposure standards of the study respondents included only in this research.

Findings and Discussion

- **Factor Analysis**

Factor Analysis (FA) is used to confirm the influencing element structure of the measurement dataset. It is thought that factors that are not immediately apparent have an impact on the scores of the observable variables. This study's primary focus is on creating pathways of causality that link hidden causes, measurement errors, and observable events. The Kaiser-Meyer-Olkin (KMO) Method may be used to determine if the data is suitable for FA. The sampling adequacy of each individual model variable and the overall model variable is evaluated. The degree of potential shared variation across several variables is quantified by the statistics. FA is often more appropriate for data with smaller percentages. The values that KMO returns range from 0 to 1. Sampling is considered sufficient when the KMO value is between 0.8 and 1.

According to Kaiser, these are the permissible limits: The following criteria have been set by Kaiser for approval:

A pitiful 0.050 to 0.059, below average 0.60 to 0.69. Middle grades often fall within the range of 0.70-0.79.

With a quality point score ranging from 0.80 to 0.89. They excel in the range of 0.90 to 1.00.

Table 1: KMO and Bartlett's Test

Testing for KMO and Bartlett's Sampling Adequacy: 0.863

The results of Bartlett's Test of Sphericity are as follows:

Approx. chi-square = 5876.745

df =190; sig = 0.000

Table 1. KMO and Bartlett's Test.

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.863
Bartlett's Test of Sphericity	**Approx. Chi-Square**	5876.745
	df	190
	Sig.	0.000

Bartlett's Test of Sphericity was used to further verify the correlation matrices' comprehensive relevance. The value of KMO sampling adequacy was 0.863. Researchers identified a p-value of 0.00 employing Bartlett's Test of Sphericity. Thus, the correlation matrix was not an identity matrix, as shown by an important test outcome from Bartlett's Sphericity Test.

Independent Variable

- **Nurse-led interventions**

Nurse-led interventions can be defined as effective healthcare-related operations organised and performed by nurses to improve the health and wellness of patients. Nurses assist patients in clinics, hospitals, social centres, and residences. Nurses aid in illness avoidance, management, rehabilitation, and health improvement through appropriate intervention strategies. Training patients, pharmacological assistance, health evaluations, counselling, and follow-ups are included in nurse-led interventions. Nurses assist patients in comprehending their ailment and options for treatment. Healthy living and self-care approaches among patients are also promoted through the intervention strategies. Both satisfaction for patients and overall patient outcomes are enhanced by these interventions through maintaining adequate communication strategies between nurses and patients (Bulto et al., 2024). Appropriate nurse-led intervention approaches may lessen the risk factors associated with health-related problems and hospital readmissions. Interaction between patients and nurses is also enhanced by nurse-led care services. Patients frequently feel better at comfortable talking to nurses about their issues. This promotes confidence and trust in medical treatments. In addition, interprofessional collaboration between nurses and other healthcare professionals and ethical practices also improve patient outcomes by providing patient-centred care services and emotional assistance (Dailah, 2024).

Dependent Variable

- **Patient outcomes**

Patient outcomes can be defined as the effects of medical treatments and services on a patient's well-being and health. The efficacy and quality of the provided healthcare services are evaluated using patient outcomes. Effective patient outcomes aid nursing staff and other health experts in determining the effectiveness of implemented interventions and therapies. In some situations, patient satisfaction and trust during therapy are also considered patient outcomes. Accurate diagnosis approach implementation, acquiring timely treatment practices and maintaining good communication with patients often lead to positive patient outcomes (Dixon et al., 2024). Conversely, therapeutic failure, onset of frequent infections, errors in medicinal treatment, or deteriorating health problems are examples of negative patient outcomes. In both healthcare studies and applications, patient

outcomes are crucial indicators to understand the efficacy of provided care services to the patients. Possible patient outcomes are used by hospitals and other healthcare organisations to assess the efficacy of treatment and locate areas that may be significantly improved. In addition, researchers investigate different dimensions of patient outcomes to get an understanding of the effects that various therapies and healthcare interventions have on patients (Ezeamii et al., 2024).

- **Relationship between nurse-led interventions and patient outcomes**

Patient healthcare outcomes and nurse-led interventions are closely related, as it is mostly nurses who are responsible for planning and implementing these interventions to promote the good health and well-being of patients. The provision of immediate care services, the monitoring of patient health conditions, the supply of appropriate education to patients, and the promotion of rehabilitation are significant roles that nurses perform. The participation and effective qualification of nurses in delivering patient-centred care services have a significant effect on the comprehensive patient health outcomes, as well as improving the standard of medical care services that are provided. One significant connection that is found between nurse-led interventions and health outcomes of patients is the enhancement of disease management measures. Qualified nurses conduct routine assessments of their patients and conduct early detection of any health issues. In addition to monitoring the advancement of therapy, nursing professionals provide appropriate emotional assistance and comfort to the patients. Patients can more successfully manage chronic conditions because of the supply of required care service assistance. Patients experience fewer health-related problems and improved health progress as a direct consequence of providing effective nurse-led interventions (Yu et al., 2024).

Nurse-directed intervention approaches are being used in hospitals and public healthcare settings to assist in lowering the costs of healthcare and the length of hospital stays. Furthermore, interaction between nurses and patients has an impact on the overall health outcomes for patients. A patient's anxiety and fear may be reduced by effective communication, which also helps to create trust. Interprofessional collaboration among healthcare professionals helps by providing patients with psychological assistance, which may enhance their mental well-being and help them recover more comfortably. Continuous monitoring and appropriate follow-up treatment are essential to avoid subsequent readmissions to hospitals. When nurses maintain ethical practices while giving personalised care, patients often report feeling more supported and valued. When patients have positive experiences, they are more satisfied with the services provided by healthcare providers and are more likely to cooperate throughout treatment. Both patient satisfaction and the value of life have been proven to increase when nurse-led treatments are implemented (Almutairi et al., 2025).

According to the mentioned discussion, researchers developed the hypothesis intending to investigate the significant relationship between nurse-led interventions and patient outcomes:

- "H01: There is no significant relationship between nurse-led interventions and patient outcomes."
- "H1: There is a significant relationship between nurse-led interventions and patient outcomes."

Table 2: H1 ANOVA Test

ANOVA					
Sum					
	Sum of Squares	**df**	**Mean Square**	**F**	**Sig.**
Between Groups	83,746. 439	250	8439.743	1131.636	0.000
Within Groups	837.894	527	7.458		
Total	84,584.333	777			

The current research study determined substantial results. Statistical significance was accomplished with a p-value of 0.000, which indicated an alpha level less than 0.05 and an F-value of 1131.636. This indicated that the null hypothesis was rejected; on the other hand, the alternative hypothesis, "H1: There is a significant relationship between nurse-led interventions and patient outcomes", was accepted.

The findings of the study determined that nurse-directed intervention approaches and patient outcomes had a statistically significant connection. The dataset was discovered to be adequate for FA, and the research variables demonstrated acceptable interrelationships. The interrelationship was established through the distinct value of KMO of 0.863, which showed adequate sampling adequacy. Further, Bartlett's Test of Sphericity provided a significance value of 0.000, demonstrating that significant connections existed among the identified research variables and helping the practicality and reliability of the analytical model. Additionally, the results of the ANOVA test displayed a significantly favourable finding, with a distinct p-value < 0.05 and an F-value of 1131.636. The null hypothesis had been rejected; however, the alternative hypothesis had been accepted based on the acquired statistical findings. The statistical findings substantiated that effective nursing practices, including early detection of complications, regrading patients' needs and preserving confidentiality of patients' information, helped in the betterment of patient outcomes. The higher F-value additionally demonstrated a substantially predictive connection between the identified independent variable, nurse-led interventions, and the recognised dependent variable, patient outcomes. The study also discovered that sufficient nurse-led intervention strategies contributed to enhanced rates of patient recovery, more suitable treatment administration, boosted patient satisfaction, and comprehensive quality of delivered patient-focused healthcare services. Nursing practices which include patient instruction, continued monitoring, psychological assistance, and blended care services positively impact patient well-being and overall healthcare experiences for patients.

The findings of the study investigated the influential connection between nurse-led interventions and patient health outcomes and showed that intervention approaches implemented by nurses critically improved the overall standard of patient healthcare outcomes. The research also revealed that nurse-led intervention strategies contributed to more satisfactory patient recovery rates, boosted patient satisfaction, enhanced treatment compliance, and lowered rates of hospital readmission. Nurses played an essential role in helping patients throughout the process of treatment by providing health-related education, scrutinising disease symptoms at an initial stage, and showing emotional support. These effective nursing practices assisted patients in better understanding their health-focused needs and facilitated them to pursue clinical advice and treatment planning more

effectively provided by nurses. As a result, patients encountered enhanced biological and emotional well-being and more favourable healthcare experiences. The current research also emphasised that nurse-led intervention approaches encouraged continuity of provided care services and amplified interaction among nurses, other healthcare professionals and patients. The results of the research also determined that nurse-directed intervention techniques facilitated patient faith and confidence in the delivered healthcare services, as patients obtained personalised care and continued assistance from nursing professionals.

According to the study, several factors associated with nurse-led interventions significantly influenced patient healthcare outcomes. Nurse qualification emerged as one of the most significant elements because positively educated, qualified, and skilled nurses showed more robust medical competence, ability to think critically, and decision-making agility. Qualified and skilled nurses were more competent in incorporating practical treatment techniques, handling patient health-related complications, and providing evidence-focused care services. Their skilled understanding contributed to facilitating healthcare efficacy and more satisfactory patient health outcomes. The study also determined maintenance of nurse-patient communication as a significant element affecting patient healthcare outcomes. Adequate communication approaches promoted nurses to comprehend patient problems, identify patients' healthcare requirements, and deliver patient-centred healthcare services. Transparent and empathetic communication approaches decreased patient anxiety and disorder while promoting patient involvement in healthcare decision-making approaches. Similarly, interprofessional collaboration was discovered to strengthen favourable patient health outcomes by boosting cooperation between nurses and other healthcare professionals. Collaboration enabled proper decision-making, consistency of care services, and decreased the probability of clinical mistakes. The current research underscored the significance of the implementation of ethical standards in effective nursing practices. Ethical nursing conduct elevated patient satisfaction, confidentiality and security standards during the process of treatment. By upholding professional standards and appreciating patient privileges, nurses contributed to more significant patient trust, dignity, and delivery of quality healthcare services.

Implications

The research results may harbour significant implications for the fields of nursing practices, delivery of effective patient healthcare, different healthcare institutions, and future studies. The study may also help emphasise the significance of boosting clinical skills of nurses and proficiency in decision-making. Hospitals and other healthcare associations may utilise the findings of the research to create effective training programmes that can promote nurses' acquaintance and appropriate communication skills. In addition, the research may assist policymakers in identifying the significance of nurse-led healthcare models in health settings. Therefore, guidelines may be designed to improve nurse involvement in patient administration and appropriate healthcare planning to boost patient outcomes. The present study findings may also encourage improvement in nursing education. Henceforth, nursing students may become more composed to manage complicated patient conditions in medical settings. In the context of future research, the research may facilitate further exploration into various kinds of nurse-led intervention strategies across healthcare settings and patient populations. Future researchers may also investigate strategies to promote long-term patient healthcare outcomes and evaluate the efficacy of diverse nursing techniques.

Conclusion

The present research concluded that nurse-led interventions played an important function in boosting patient outcomes across healthcare settings. The findings of the research revealed that nurse-directed interventions helped in delivering better patient care, enhancing recovery rates, and increasing patient satisfaction. The research also discovered that intervention approaches provided by nurses decreased health-associated problems and encouraged convenient identification of patient requirements. Further, the study emphasised that adequate nurse-patient communication positively influenced the development of patient trust and active involvement during treatment processes. Adequate communication approaches allowed nurses to clearly and understandably clarify clinical situations, treatment planning, and care education to patients. This motivated patients to convey their references, ask questions, and be involved in healthcare decision-making approaches. The results also presented that those qualified and skilled nurses supplied more convincing intervention techniques because of their medical knowledge, applicable understanding, and skilled competence. The distinct capacities contributed to enhanced rates of patient recovery, decreased complications, and more satisfactory comprehensive medical outcomes. Further, interprofessional collaboration boosted patient healthcare services by fostering teamwork between nurses and other healthcare professionals. Such an association assisted in correct decision-making aspects, corresponded to care plans, and ensured continuity of provided healthcare services. The study also highlighted that ethical nurse-led practices played an influential role in securing patient security, confidentiality and dignity while assuring the support of high-quality and patient-centred healthcare services. Despite the favourable findings, the current study determined that deviations in healthcare settings and patient conditions may have adversely impacted the significance of nurse-directed interventions. The study findings indicated the significance of reinforcing nursing practices that can be improved through providing proper education, proficient training, adequate communication approaches, teamwork, and maintenance of ethical criteria.

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The Impact of Structured Nursing Care on Postoperative Recovery in Hubei Province

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Abstract

Nurses helped patients recover after surgery by following standard procedures and monitoring them. However, structured nursing care's effect on postoperative recovery was insufficient, especially in Hubei province. Henceforth, this study examined the effects of structured nursing care on provincial patients' post-surgical recovery. The current study collected credible research context data using a cross-sectional and quantitative design. This study selected 778 hospital nurses using a standardised questionnaire employing purposive sampling. The researcher used descriptive analysis to recognise the data's important properties and Analysis of Variance (ANOVA) to determine the research variables' relationships. The primary findings highlighted that organised nursing care improves postoperative recovery by monitoring patient routine management. The study also provided hospital proof of structured nurse care for post-surgery patients' physical and psychological requirements. This showed that the nursing care increases patient outcomes by enhancing care management and diagnostic stability. The study indicated that hospitals standardised observation, preventive care, rapid response, and medication management strategies to provide practical training for nurses. Moreover, the findings indicated that the adoption of evidence-based practices could significantly enhance post-surgical recovery for patients at hospitals in Hubei province. The conclusion of this research is that established nursing care is an important factor in improving recovery outcomes after surgery, as measured by safety, effectiveness of treatment and overall quality of healthcare in hospitals throughout Hubei Province.

Keywords: Hubei Province, Postoperative Recovery, Primary Hospitals, Structured Nursing Care

Introduction

The nursing care provided after surgery is essential to a patient's recovery when they experience operations on traumatic fractures. Traumatic fractures occur when a bone is broken or disconnected from the body and are the result of high-impact trauma Such examples of high impact trauma include high-velocity motor vehicle accidents and falls from height, to name a few. As such, medical researchers are advocating using multiple methods to help control pain. These methods can include prescribing pain medication, and utilising regional anaesthesia techniques. This encompasses providing the best level of post-surgical nursing care to promote optimal healing. In doing so, the patient will receive improved pain management, which reduces their chance of developing complications, and as such, increases the overall quality of life for patients recovering from traumatic fractures (Ni & Lou, 2025). Postoperative pain is a prominent clinical

condition that affects a substantial number of surgical patients globally. Pain after surgery is caused by tissue damage, inflammatory reactions and stimulation of the sympathetic nervous system. Nurses are essential to postoperative pain treatment, providing constant monitoring of patients and implementing pharmacological and non-pharmacological therapies. The complex clinical challenge of managing post-surgical pain and the opportunity to improve recovery and reduce complications through nursing treatments for post-surgical pain (PSP) in adult patients. Adult patients after major or minor surgery develop medium to intense PSP within 72 hours due to poor pain management (Wells et al., 2022). This can be a harrowing experience for the afflicted. All of these patients necessitate prompt medical intervention. During brainstorming sessions with all surgical unit representatives, barriers to effective postoperative pain management were determined. The identified barriers include educating patients about postoperative pain management; improving nurses' knowledge of postoperative assessment and management; having enough prescriptions made for managing postoperative pain based on type of pain; having both pharmaceutical and non-pharmaceutical alternatives available to manage pain; and creating clinical pathways for managing postoperative pain. Nursing interventions play a major role in reducing the complex clinical issues and morbidity of postoperative pain management and in the management of PSP in adult patients (Ataro et al., 2023). Furthermore, postoperative nursing care is equally about providing timely interventions for proper movement, preventing complications of surgery, emotional support, and patient education. Nurses will provide care by checking vital signs; monitoring wound healing, providing preventive measures of infection and encouraging rehabilitation work that helps postoperative patients recover faster. Through progressive observation and patient-centred care by the nursing staff, physical function improves, length of stay gets shorter, and overall patient experience is enriched after surgery. Hence, structured and thorough postoperative nursing care will enhance safe and efficacious recovery in traumatic fracture patients.

Review of Related Literature

To As a core intervention for postoperative rehabilitation, structured nursing care includes monitoring, pain management, health education and emotional support. Relevant research proves that it can reduce surgical complications, shorten hospitalisation and elevate patient satisfaction (Lu et al., 2026). Existing literature indicates that nurse-led standardised nursing optimises treatment compliance, self-management and long-term health outcomes, and cuts hospital readmission risks (Qiu, 2024; Ruksakulpiwat et al., 2025; Zhang et al., 2024). Grounded in Jean Watson’s Theory of Human Caring (1979), this study holds that holistic and humanistic structured nursing can relieve patients’ postoperative distress. It is necessary to explore the practical effects of this nursing model on surgical patients in Hubei Province.

Objectives

- To assess the influence of structured nursing care on postoperative recovery in Hubei Province

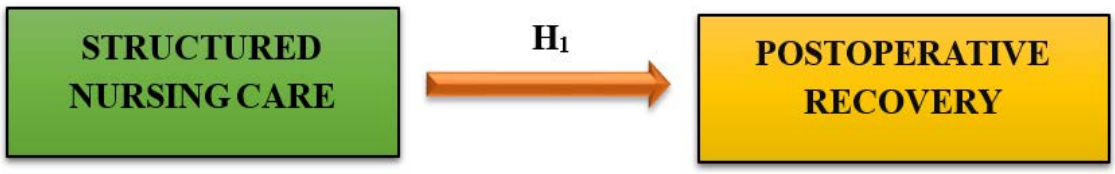
Methodology

Research Design and Procedure

This study adopted a quantitative cross-sectional design to explore the correlation between structured nursing care and postoperative recovery among surgical patients

across several hospitals in Wuhan, Hubei Province. This design was selected to analyse the relationships between research variables and quantify relevant characteristics.
Data were collected via self-administered online questionnaires. The questionnaire items were compiled based on the research variables and well-established domestic and foreign scales. A pilot study was conducted prior to formal data collection to verify content and construct validity. Cronbach's Alpha coefficient was calculated to test the internal reliability of the questionnaire. All collected data were processed and analysed using IBM SPSS Statistics 25.0. A 95% confidence interval was set to assess the direction and strength of correlations between variables, and a p-value less than 0.05 was defined as the threshold for statistical significance. Descriptive statistics were used to summarise the basic characteristics of the dataset, and one-way Analysis of Variance (ANOVA) was applied to examine differences between groups.

Operational Framework



Subjects or Data Sources
Sampling Method & Rationale
Purposive sampling was adopted in this study. This method was chosen because it enables targeted recruitment of frontline clinical nurses engaged in postoperative care, ensuring all participants possess professional working experience closely related to the research theme and improving the pertinence of samples.

Sample Size Calculation
The minimum sample size was calculated using Raosoft software with standard parameters: 95% confidence level and 5% margin of error. The software suggested an optimal sample size of 384. To account for invalid responses and non-participation, a total of 825 questionnaires were distributed. Ultimately, 812 questionnaires were retrieved. After excluding 34 incomplete and logically inconsistent responses, the final valid sample size was 778.

Sampling Criteria
Inclusion criteria: Full-time clinical nurses working in selected hospitals of Wuhan; engaged in postoperative nursing work; voluntary participation in this survey.

Exclusion criteria: Intern nurses, rotating staff, and nurses on long-term leave.

Participant Characteristics
All 778 participants were clinical nurses from general and specialised surgical departments of local hospitals. The sample covered different age groups, working years, professional titles and educational backgrounds, which can generally reflect the overall status of postoperative nursing staff in the surveyed hospitals.

Instrumentation and Data Analysis

Raosoft software was used to calculate the sample size with a 95% confidence level and a 5% margin of error. The minimum required sample size was determined as 384 to ensure population representativeness and control sampling error.Purposive sampling was implemented to select participants. This method was chosen to target professional nurses with postoperative care experience, which matches the research objectives. All respondents were screened in accordance with unified inclusion and exclusion criteria.Microsoft Excel was used for data arrangement, while SPSS 25.0 was used for statistical analysis. Descriptive analysis was adopted to describe data features, and ANOVA was utilised to analyse the correlations between research variables.

Limitations

The study faced several limitations inherent in quantitative research. The study was conducted in a few hospitals in Wuhan city, Hubei Province, China. Therefore, its result was not be very applicable to nursing methods, patient demographics, or healthcare systems in other Chinese regions. The use of closed-ended survey questions restricted respondents from providing in-depth explanations, which limited the ability to capture nuanced opinions or contextual factors influencing their perceptions of structured of nursing care and postoperative recovery. The large sample size was enough because some study participants did not return the research questionnaires, and the sample size did not fully represent the total specified population. This limited the overall validity and dependability of the quantitative data that was gathered. However, two distinct factors can adversely affect the generally observed success rate: insufficient time and a lack of requested financial support. Moreover, the researcher faced additional challenges in securing permission from the management of several associations to survey their respective workforces. Quantitative data oversimplified the influence of Post-operative recovery: organised nursing care. Additionally, collecting data only from hospital created issues related to the representation of generalised findings on the research topic. The cross-sectional design limited the study's ability to establish causality, as the data captured relationships at a single point in time rather than changes over time. Finally, the findings were not fully generalisable beyond the sampled population, as the results are influenced by the demographic characteristics and media exposure patterns of the respondents included only in the study.

Analysis

The Exploratory factor analysis (EFA) was performed to examine the construct validity of the questionnaire and extract latent variables from observed items. The Kaiser-Meyer-Olkin (KMO) Test and Bartlett's Test of Sphericity were first applied to verify sampling adequacy for factor analysis. The KMO value ranges from 0 to 1; a value above 0.8 indicates good sampling adequacy, while a value between 0.9 and 1.0 represents excellent suitability.

Table 1: KMO and Bartlett's Test for Sampling Adequacy

KMO and Bartle's Test		
Kaiser-Meyer-Olkin measure of Sampling Adequacy		0.924
Bartlett's Test of Sphericity	Approx. Chi-Square	5821.325
	df	190
	Sig	0.000

As shown in Table 1, the KMO value was 0.924, indicating excellent sampling adequacy. Bartlett's Test of Sphericity yielded P<0.05, which confirmed significant correlations between research variables, so the dataset was suitable for factor analysis.
Principal component analysis with varimax rotation was further conducted. The results demonstrated that all factor loadings of questionnaire items ranged from 0.63 to 0.88, exceeding the standard threshold of 0.6, which proved each item had strong correspondence with its corresponding dimension. In total, 5 common factors were extracted, matching the preset construct dimensions of the questionnaire: routine monitoring, pain management, health education, emotional support and rehabilitation guidance. The cumulative variance explained reached 72.46%, higher than the 60% standard for social science research, meaning the extracted factors could adequately interpret the information of all original variables.

Independent Variable
Structured Nursing Care
'Structured nursing care' refers to a systematic approach to planning and evaluating patient care using specific procedures, clinical guidelines and carefully planned care approaches. This makes certain that specific processes and best practices, rather than being purely influenced by personal concerns direct interventions by nurses. This ensures that nursing interventions are guided by clearly defined procedures and best practices rather than solely by personal considerations (Cusack et al., 2023). In the nursing literature, nurses, patients/families, or nurse managers often discuss quality of care. It is associated with professional commitment, quality of patient care, and the retention and satisfaction of nursing staff. Regulatory organisations in the nursing field formulate standards of practice, regulations, and guidelines that delineate the obligations and responsibilities of nurses in delivering safe and high-quality care. Patients can articulate their impressions of nursing care quality via patient satisfaction, assessed through principles, experiences, requirements, and needs. The satisfaction of patients' data is a prevalent method employed in healthcare institutions to assess service quality, which can be gathered and reported via patient surveys, commendations, or grievances (Arwan et al., 2024). Nurses assume diverse roles in delivering hospice services to children across many environments. A persistent paucity of nurses certified to deliver PPC remains evident. Paediatric nurses generally possess insufficient official training in critical care and support mechanisms to assist children in managing the emotions related to death. Though educational programs on palliative care for adults exist for palliative care providers and paediatricians, no such programs are available for post-graduate students in nursing or nurses in paediatric departments. Numerous nurses encounter challenges in delivering palliative care, potentially leading to children and families in need being deprived of sufficient or suitable assistance. In addition, numerous nurses encounter challenges in delivering palliative care, potentially leading to children and families in need being deprived of sufficient or suitable assistance (Zhang et al., 2024).

Dependent Variable
Postoperative Recovery
Post-operative ileus (POI) is a condition characterised by disrupted gastrointestinal motility that arises after abdominal surgery. The prevailing belief regarding post-operative gastrointestinal paralysis is erroneous, as the distal colon exhibits hyperactivity following surgery. Post-operative inflammatory responses significantly influence the pathophysiology of ileus; yet, their duration in humans remains ambiguous, with the majority of evidence derived from animal models. Lung cancer is among the tumours

with the greatest morbidity and fatality rates in China and globally. Video-assisted thoracic surgery (VATS) is utilised in lung cancer treatment because of its benefits of reduced surgical trauma, minimal postoperative problems, and expedited recovery (Wells et al., 2022). In China, a surgical thoracoscopy was employed in fifty percent of lobectomies. Early ambulation is a critical sign of Enhanced Recovery after Surgery (ERAS). Besides averting lung infections, pressure ulcers, and lower limb deep vein thrombosis, early ambulation facilitates the recovery of respiratory, digestive, and muscular functions. In recent year, the extensive implementation of ERAS protocols has led to heightened interest in early ambulation post-surgery. The objective is to examine the attributes of quick ambulation therapy and surgical rehabilitation in lung cancer patients after thoracoscopic surgery, to establish a guideline for determining the timing and specific strategy for rapid ambulation following lung cancer surgery (Mert, 2023).

Relationship between Structured Nursing Care and Postoperative Recovery

The relationship between structured nursing care and postoperative recovery is considered a strong connection, as structured and patient-centred nursing interventions are key factors in determining the overall healing process and the overall postoperative outcome for patients after surgery. Nurses provide essential services to patients following surgery that include continuous monitoring of vital signs, administration of medications for pain relief, providing emotional support, educating patients about their conditions, and directing them in the process of rehabilitation. By fulfilling these responsibilities, nurses help patients complete a safe and effective recovery from surgery along with decreasing what would typically be an increased risk for complications and having an improved overall experience with their health care (Kulakaç & Sayılan, 2024).

A significant connection between structured nursing care and postoperative recovery is that it assists with patient management regarding improving their ability to manage their health. Competent and skilled nurses continually assess their patient's physical conditions, monitor their patients' vital signs, and notice any signs of early postoperative complications. By having timely interventions along with developing a plan of care, nurses assist their patients with pain management, prevention of infection, and maintaining physical stability while recovering from surgery. In addition, assessing their physical condition, monitoring their vital signs, and identifying early signs of future postoperative complications enables nurses to provide patients with appropriate direction for medication administration, wound care, mobility, and healthy lifestyle behaviours that will assist in their healing process and improve their overall postoperative outcomes (Mert, 2023).

Communication between the nurse and the patient is crucial for recovery after surgery. Patients experience a number of feelings based on their surgery, including anxiety, fear, stress, and some discomfort. Structured nursing helps support a trusting bond with the patient through the use of open and compassionate communication and emotional support. If the patient feels better and supported by the medical staff, the more compliant they will be with medical procedures and rehabilitation activities, which will ultimately help speed up the recovery of the patient. Structured nursing also improves patient satisfaction and decreases the length of time the patient spends in the hospital. By coordinating nursing interventions and continually following up with patients, nurses can drastically decrease the rate of readmission to the hospital after surgery, as well as decrease the risk of complications from surgery. Health care professionals can work together effectively for total patient management through collaborative work, meaning

that total patient care can improve as well. By providing ethical nursing care and using a patient-centred approach, the patient feels cared for, respected, and at ease during their medical care; thus, they have more confidence in the health care system (Ataro et al., 2024).

According to the discussion, involved researchers have developed the mentioned hypothesis to investigate the meaningful connection between Structured Nursing Care and Postoperative Recovery:

"H01: There is no significant relationship between Structured Nursing Care and Postoperative Recovery."

"H1: There is a significant relationship between Structured Nursing Care and Postoperative Recovery."

Table 1. Independent Sample Size Effects.

ANOVA					
Sum					
	Sum of Square	Df	Mean Square	F	Sig.
Between Groups	82,758,458	513	8564.256	1187.256	0.000
Within Groups	785.821	264	7.214		
Total	83,554.279	777			

ANOVA results: F = 1187.256, P<0.05. The null hypothesis was rejected. The high F-value indicates a very strong between-group difference. Combined with the large sample size (N=778), this result proves that structured nursing care has a significant and stable positive impact on postoperative recovery, and the research conclusions are reliable.

Findings and Discussion

The This study verified a statistically significant positive correlation between structured nursing care and postoperative recovery among surgical patients in Hubei Province. The overall dataset passed all validity tests for factor analysis (FA). The KMO value of 0.924 and a p-value of 0.000 for Bartlett's Test of Sphericity confirmed excellent sampling adequacy and strong correlations between observed variables. Further exploratory factor analysis yielded solid structural validity: all item factor loadings ranged from 0.63 to 0.88, exceeding the academic threshold of 0.6. A total of five construct dimensions were extracted, including routine monitoring, pain management, patient education, emotional support and rehabilitation guidance, which were consistent with the theoretical framework of this research. The cumulative variance explained reached 72.46%, indicating that the extracted factors could sufficiently interpret the original data information.

The one-way ANOVA produced an F-value of 1187.256 ($P < 0.05$), leading to the rejection of the null hypothesis. This extremely high F-value reflects a substantial difference in postoperative recovery across groups receiving different levels of structured nursing interventions. On the one hand, it proves that each component of structured nursing care exerts a strong predictive effect on patients' rehabilitation outcomes. On the other hand, the large sample size ($N = 778$) effectively improves statistical test power, making the group difference more prominent. Combined with the significance level, this result fully demonstrates the stability and reliability of the research conclusion.

The research findings are highly consistent with prior relevant studies. Qiu (2024) confirmed that standardised nurse-led interventions optimise doctor-patient communication and clinical decision-making, which aligns with our conclusion that emotional support and health education improve patient compliance. Ruksakulpiwat et al. (2025) and Zhang et al. (2024) also reported that systematic nursing interventions reduce complications, shorten hospital stays and enhance patients' self-management ability. This study further supplements regional empirical evidence from Hubei Province and proves the universal applicability of structured nursing models in local clinical settings.

Different from general nursing research, this study targets postoperative patients in local hospitals and highlights the practical value of whole-process standardised care. Integrated nursing practices including real-time condition monitoring, early complication screening, scientific pain control, psychological counselling and rehabilitation guidance can comprehensively improve patients' physical and mental wellbeing, reduce postoperative complications and elevate patient satisfaction. Smooth nurse-patient communication and interdisciplinary collaboration further optimise patients' treatment experience.

In terms of theoretical application, this study echoes Jean Watson's Theory of Human Caring. The humanistic and patient-centred concept embedded in structured nursing builds mutual trust between medical staff and patients, relieves postoperative anxiety and stress, and forms a virtuous cycle for rehabilitation. In summary, structured nursing care is a core driving factor for improving postoperative recovery and overall healthcare quality in Hubei Province. Hospitals should continue to standardise nursing workflows and strengthen professional training for nurses to maximise the benefits of this care model.

This study found that there was a significant correlation between the provision of organised, structured forms of nursing intervention and the recovery from surgery that occurred post-operative. Performing the structured nursing interventions greatly improved the overall recovery accrual of post-operative patients who were treated in facilities located within Hubei, China. An additional finding in this study was that providing structured forms of nursing care allowed for: much faster post-operative recovery, increased levels of patient satisfaction, decreased post-operative complications, and enhanced levels of both physical and psychological health for surgical patients. Nurses provided a key function in the post-operative support systems of the patients by offering continuous monitoring, pain control, emotional support, rehabilitation directions, and education regarding health concerns. Through these evidence-based nursing practices, nurses assisted patients in better understanding the necessary requirements of the post-operative period and encouraged them to more effectively follow the guidelines of their treatment plan and recovery.

The results of this study also identified that the provision of structured nursing care facilitated a continuum of healthcare service delivery and improved the communication between nurses, patients, and the other members of the healthcare delivery team. Patients who received nursing care that was organised and centred on their individual needs established a stronger level of trust and confidence in the healthcare system through the receipt of more personalised nursing care and assistance from nursing personnel. The study also showed that various aspects of organised nursing care had a big effect on recovery after surgery. One of the most notable aspects to assist patients with recovery

after their operation is the nurse's qualifications. This would include how advanced or skilled and the amount of experience that a nurse possesses. The higher the qualifications, skills and knowledge of the nurse leading up to the postoperative period would provide them with the ability to care for the patient postoperatively through clinical competence, critical thinking, and decision-making when caring for patients having just had surgery. This study also took into consideration the communication between the nurses and the patients after surgery. Furthermore, the study emphasizes the importance of ethical nursing to support the dignity, confidentiality, and trust of the patient while providing high quality post-operative nursing, care and services

Implication

The findings from this study could affect areas such as nursing practice, managing the postoperative patient, health care delivery systems, and future research efforts. The findings from the study indicate that providing nursing care using a structured approach will improve patient recovery after surgery, improve patient satisfaction with overall quality of care provided in the health care system, as well as the provision of structured nursing care will result in better outcomes for patients when they are discharged from the hospital. Therefore, hospitals and other health care organisations could use these findings to help develop their nursing care models to support nurses in developing and implementing effective training programs and subsequently improving the clinical competency, communication skills, and postoperative management skills of their nurses. Therefore, the findings of the study could assist policy-makers when developing and revising health care policies and guidelines that would increase the level of involvement by nurses in the postoperative patient monitoring, rehabilitation, and planning of patient-centred care. The findings of the study could be used to influence the education of future nurses by encouraging nursing programmes to more frequently include structured nursing care practices when teaching future nurses about the delivery of nursing care for post-surgical patients. Finally, as a future research opportunity, the study provides an opportunity for researchers to further examine the different nursing care models available in the health care system and the long-term effects of those nursing care models on postoperative recovery of varied groups of patients.

Conclusion

The conclusion of this study shows that structured nursing care made a substantial impact on the postoperative recovery of patients located in Hubei Province. The results from this research demonstrated that organised nursing interventions lead to improved recovery times, increased patient satisfaction, reduced incidence of postoperative complications, and increased levels of physical and mental well-being for surgical patients. Patients received assistance through the following structured nursing care practices to support their recovery: continuous patient assessment and monitoring; management of pain; emotional support; educating patients; and guidance for rehabilitation. Each of these nursing care practices provided a means for patients to better understand how to care for themselves during the postoperative period and how to actively participate in their course of treatment and their recovery. Research has shown that good communication between nurses and patients can help nurses develop good patient trust and confidence as well as encourage patient collaboration during recovery after surgery. This can lead to less anxiety for the patient and a much better overall experience with healthcare. In addition, interdisciplinary collaboration between healthcare professionals allows for quality in the delivery of postoperative healthcare services through working as a team and providing cooperation amongst one another. Ethical standards in nursing care also have been shown

to have a positive impact on patient dignity, confidentiality, safety, and patient-centred care.

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Socio-Psychological Determinants of Journalists' Professional Activity

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Abstract

This research paper analyses the socio-psychological characteristics, professional portrait, and creative systemic role of journalists operating within contemporary mass media through the lens of empirical sociological and psychological methodologies. The study sample draws on extensive sociological surveys (questionnaires) and psychological profiling conducted among 120 professional journalists active within television and radio broadcasting companies, print media houses, and digital internet journalism newsrooms in the Republic of Karakalpakstan. The article explores the levels of reflective and non-reflective listening within communication structures, spatial proxemic boundaries governed by neurobiological mechanisms, and the intricate matrix of professional motivation and emotional burnout. The findings provide deep theoretical insights and practical frameworks for optimizing editorial group dynamics and preventing occupational hazards in regional media environments.

Keywords: Communication Psychology, Journalist Personality, Proxemics, Reflective Listening, Socio-Psychological Portrait

Introduction

Under the contemporary conditions of globalization, intense digital transformation, and the exponential expansion of the information ecosystem, the mass media has systematically integrated into all dimensions of social life, establishing itself as a highly influential macro-institution that actively shapes social relations, public opinion, and collective consciousness. At the core of this dynamic and complex media architecture, serving as its core functional and ideological driving mechanism, stands the personality of the journalist. A journalist's intellectual capacity, socio-psychological stability, ethical value metrics, and communicative competencies directly predetermine the level of objectivity, credibility, and impartiality of the information streams disseminated to society.

By its inherent social and occupational nature, the profession of journalism demands high operational dynamics, sustained psychological-emotional workloads, continuous interactive communication with diverse social strata, and immediate, decisive decision-making under conditions of chronic time deficits and strict deadlines. This demanding environment, in turn, generates a critical academic and practical necessity to scientifically investigate the individual-psychological and socio-psychological parameters of newsroom personnel, systematically structuring their professional profile based on empirical sociological criteria.

Reviewing the historical trajectory and theoretical foundations of this fundamental scientific problem reveals that journalistic creativity and its psychophysiological nature have long been investigated at the interdisciplinary crossroads of philosophy, sociology, cultural studies, and behavioural psychology. Specifically, the capacity of mass media to manipulate public consciousness, alongside the socio-psychological attractiveness and persuasive authority of the journalist's personality, has been extensively analysed in the foundational works of S.G. Kara-Murza and L.V. Trubitsina. These studies theoretically proved that information security within the media space and individual exposure to trauma are intrinsically linked to the journalist's emotional intelligence.

Furthermore, the psychology of journalistic creation, the socio-psychological climate of editorial working environments, and professional communication cultures have been methodologically established by prominent researchers such as V. Agranovsky and A.A. Andreeva. Within the regional academic context, fundamental laws of personal socialization, psychological barriers in interaction, and social-communicative phenomena have been systematically investigated by Professor V. Karimova, while the specific subject-object dynamics within mass communication systems were rigorously evaluated by E. Kholiqov. Nonetheless, despite the availability of these diverse theoretical lineages, the socio-psychological portrait of journalist cadres within the specific regional socium of the Republic of Karakalpakstan—particularly accounting for unique ethno-cultural and territorial components—has remained under-researched as a holistic, empirical-sociological entity. The absolute necessity to address this conspicuous academic gap defines the primary objective of this research paper.

Review of Related Literature

The socio-psychological dimensions of journalism have been widely explored, with scholars emphasizing the interplay between individual psychology, media practices, and societal influence. Nurgaliyeva (2025) provides a focused examination of Karakalpakstan journalists, constructing a socio-psychological portrait that highlights the pressures and responsibilities inherent in journalistic activity. This aligns with Karimova's (2012) foundational work in social psychology, which underscores the role of interpersonal dynamics and social context in shaping professional behaviour.

Kholiqov (2011) and Kara-Murza (2003), both of whom discuss manipulation and the "false world" created by mass communication, offer critical perspectives on media influence. Their analyses reveal how journalism can both inform and distort public consciousness, raising ethical concerns about the profession. Trubitsina (2001) extends this discussion by examining the traumatic impact of media on journalists themselves, particularly in emergency situations, thereby situating journalism within a broader framework of psychological resilience. Agranovsky (1999) and Andreeva (2018) contribute to understanding journalistic creativity, portraying journalism as both a profession and an art form that requires psychological adaptability and innovation.

Sharkov (2010), who provides a comprehensive account of communication theory, situating journalism within broader communicative processes, further elaborates the theoretical underpinnings of communication. Complementary insights from neuroscience and proxemics, such as Kennedy and Adolphs (2009) on the amygdala's role in regulating personal space, and Hall's (1963) pioneering work on proxemics, enrich the understanding of how journalists navigate spatial and psychological boundaries in their interactions. Collectively, these studies establish a multidimensional framework for

analysing the psychological, social, and communicative aspects of journalism, offering valuable perspectives for contemporary research on journalistic identity and practice.

Objectives

This research aims to systematically investigate the socio-psychological parameters that define the professional identity of journalists under contemporary conditions of globalization and digital transformation. By focusing on intellectual capacity, emotional stability, ethical values, and communicative competencies, the study seeks to establish how these individual traits influence the credibility, impartiality, and objectivity of information streams disseminated to society.

Another central objective is to critically examine the historical and theoretical foundations of journalistic creativity and its psychophysiological nature. Drawing on interdisciplinary perspectives from philosophy, sociology, cultural studies, and psychology, the study intends to highlight how media manipulation, emotional intelligence, and resilience shape both the journalist's professional role and their vulnerability to trauma. This analysis provides a framework for understanding the socio-psychological climate of editorial environments and the communicative cultures that sustain journalistic practice.

Finally, the research is directed toward constructing a socio-psychological portrait of journalists within the specific regional context of Karakalpakstan. By accounting for ethno-cultural and territorial components, the study seeks to address the existing academic gap and provide an empirically grounded profile of newsroom personnel. This objective ensures that the research contributes not only to broader theoretical discourse but also to localized understanding, offering insights that can inform both professional development and media policy in the region.

Methodology

The methodological framework and empirical database of this investigation are strictly grounded in the principles of scientific objectivity, neutrality, systematic analysis, and comparative sociological inquiry. To capture the actual operational parameters that delineate the socio-psychological profile of regional media professionals, the study deployed a rigorous questionnaire-based survey methodology. The target object of research comprised journalists legally operating across both state-funded and independent, private mass media editorial offices within the territory of the Republic of Karakalpakstan.

During the primary empirical data collection phase, a sample size of N = 120 professional journalists was selected using strict probability sampling techniques to guarantee representativeness. The structured socio-demographic composition of the respondents was organized according to several primary metrics: gender distribution reflected 55% male and 45% female media professionals; age categorization indicated that young cadres aged 22 to 30 comprised 35%, mid-career experienced professionals aged 31 to 45 accounted for 45%, and senior professionals aged 46 and above constituted the remaining 20% of the cohort. Regarding their specific field of media practice, 40% of the participants were active in television and radio broadcasting companies, 30% operated within traditional print media houses, and 30% represented digital internet publications and contemporary social media newsrooms.

To evaluate the inter-subjective interactive competencies of journalists within professional communication systems, established psychological methodologies measuring social norms of interaction were implemented, focusing specifically on reflective and non-reflective listening paradigms within information processing. Concurrently, the spatial arrangements and structural physical distances maintained during interactions were examined by applying the socio-psychophysiological parameters of proxemics theory. The accumulated primary quantitative data were processed utilizing mathematical-statistical software and tabulated for systematic academic interpretation.

Findings and Discussion

The execution of the empirical sociological survey and cognitive-psychological profiling revealed characteristic statistical distributions that define the current portrait of journalists within the Karakalpak media environment. Initially, the study evaluated the professional listening cultures and cognitive information-processing behaviours of journalists when interacting with respondents, information sources, and media protagonists. Communication psychology strictly differentiates between active, emotionally grounded reflective listening and passive, controlled non-reflective listening. The empirical data demonstrated that the strategic application of these techniques displays significant variation when cross-referenced with gender attributes, as systematically illustrated in Table 1.

Table 1. Independent Sample Size Effects.

Professional Listening Style and Type	Male Journalists (%)	Female Journalists (%)
Reflective Listening (Active-Emotional, Interactive)	38%	62%
Non-Reflective Listening (Passive-Restrained, Rational)	62%	38%

Academic interpretation of the tabulated metrics demonstrates that while listening and information perception styles are evenly distributed across the general population, female journalists display a pronounced preference (62%) for the reflective listening model, which prioritizes the establishment of deep psychological-emotional rapport and inter-subjective understanding. Conversely, male journalists preferentially execute the non-reflective listening tactic (62%) during field material gathering, prioritizing structured factual accumulation. This statistical dichotomy reveals distinctly gendered strategic approaches to media content generation within the socio-psychological profile. The subsequent key parameter investigated concerns the spatial-physical boundaries maintained during interpersonal communication, namely proxemic metrics. Within human interactive systems, the demarcation and maintenance of personal space boundaries is not merely a product of conventional social etiquette or cultural training; it represents a deep-seated phenomenon rooted in neurobiology and psychophysiology. Advanced cognitive neuroscience demonstrates that the inviolability of personal space is directly regulated by the amygdala—a specialized subcortical brain structure responsible for emotional processing, threat assessment, and survival instincts.

The amygdala continuously scans the immediate environment for the physical proximity of external objects and other individuals. If an unfamiliar person penetrates an individual's personal boundary without authorization, the autonomic nervous system is instantly triggered, activating protective homeostasis mechanisms. Psychophysiological experiments indicate that the ideal volume of personal space and spatial distance needs vary by gender due to distinct hormonal and neurofunctional systemic architectures. In

females, higher basal levels of the hormone oxytocin stimulate heightened social empathy, interpersonal trust, and a preference for close-range interactive bonds, which effectively downregulates the 'apprehension' signalling cascade within the amygdala. Consequently, their personal space boundaries contract, rendering closer physical proximity biologically comfortable during communication.

In contrast, the neurophysiological profile of males is characterized by the dominance of testosterone and evolutionary neurophysiological adaptations geared toward territorial defence, dominance display, and the remote monitoring of potential threats. Consequently, the male amygdaloid system exhibits significantly higher reactivity (stress response) to close-range visual and physical contact, generating a biological drive to maintain a formal, social-consultative distance to stabilize internal physiological parameters. The actual field data regarding journalists' preferred spatial positioning during the interviewing process are systematically codified in Table 2.

Table 2. Spatial Distance Indicators during Communication (Proxemics)

Communication Distance (Proxemic Metrics)	Male Journalists (%)	Female Journalists (%)
Intimate/Personal Distance (Personal Zone: 0.5 – 1.2 meters)	25%	75%
Social/Consultative Distance (Formal Zone: 1.2 – 3.5 meters)	75%	25%

The proxemics analysis clearly demonstrates that the absolute majority of female journalists (75%) find it optimal to enter the personal zone (0.5 – 1.2 meters) to foster psychological proximity and enhance the sincerity of the respondent. On the contrary, 75% of male journalists strictly enforce a formal social distance (1.2 – 3.5 meters), utilizing spatial separation to preserve professional neutrality, detachment, and objective distance. These empirical statistical indicators serve as concrete evidence of how neurobiological drives for homeostatic balance manifest as distinct professional styles within social environments.

Furthermore, the investigation evaluated a critical component of the journalist's socio-psychological profile: core occupational motivation and the matrix of factors inducing professional deformation (burnout). When evaluated through the theoretical framework of Abraham Maslow's hierarchy of needs, altruistic social duty, public service, and professional recognition emerged as paramount motivational drivers. The distribution of responses to the question 'What constitutes the primary incentive for your journalistic activity?' is structured in Table 3.

Table 3. Socio-Psychological Motivational Factors Driving Journalistic Activity

Professional Motivational Factors	Overall Result (%)
Social Duty, Public Service, and Social Justice	48%
Professional Prestige, Fame, and Public Image	30%
Financial Compensation, Material Security, and Stable Salary	22%

The motivational analysis reveals that for 48% of journalists in Karakalpakstan, the supreme ethical incentive is the realization of social justice and rendering tangible

assistance to citizens. However, the low prioritization of material compensation (22%) establishes a critical vulnerability for the onset of occupational burnout syndrome. In the diagnostic section of the survey, 40% of the editorial personnel explicitly confirmed suffering from chronic psychological-emotional exhaustion and depressive symptoms resulting from continuous engagement with distressing social problems and systemic crises.

Discussion. The real statistical data gathered through empirical inquiry require deep contextualization within the paradigms of communication psychology, cognitive neuroscience, and mass communication theories. The affinity of female journalists for reflective listening (62%) and closer proxemic proximity (75%) is directly explained by higher base levels of emotional intelligence and empathy. As noted by Professor V. Karimova, female subjects display heightened sensitivity in rapidly decoding both verbal and non-verbal signals. Analyzing this phenomenon from a neurobiological standpoint, the seminal works of E. Kennedy and J. Adolphs proved that proxemic distance is actively regulated by the amygdala to preserve homeostatic equilibrium. Therefore, the spatial variance observed between male and female journalists is not merely an ongoing social habit; it represents a functional psychophysiological adaptation mechanism embedded within the subjective communicative process.

Conversely, the strict enforcement of formal distance (75%) and the tactical deployment of non-reflective, passive listening (62%) by male journalists confirms a highly rationalized, fact-centric operational model, reflecting the integration of evolutionary defence systems into professional frameworks. As V. Agranovsky noted, maintaining communicative distance allows a journalist to suppress subjective biases, ensuring a detached view of the data. Furthermore, S.G. Kara-Murza emphasizes that the persuasive power of media messages over public consciousness depends heavily on the perceived credibility and authority of the journalist. In our empirical sample, the fact that 48% of respondents identify social duty and justice as their primary operational metric indicates a robust ethical core within the regional media ecosystem.

However, the concurrent 40% rate of severe emotional exhaustion directly correlates with L.V. Trubitsina's [5] theoretical frameworks regarding the traumatic and stressful conditions characteristic of media professions. The synthesized integration of neurobiological and sociological factors demonstrates that the deliberate selection of ideal proxemic distances and the cultivation of refined communication cultures can serve as vital preventive instruments against professional deformation among media workers.

Conclusion

Based on the empirical, sociological, and neurobiological analysis of the socio-psychological profile of journalists operating in the mass media of the Republic of Karakalpakstan, the following fundamental scientific and practical conclusions have been reached:

1. The socio-psychological portrait of the contemporary journalist is a complex, integrated system composed of interconnected elements, including gender-specific psychophysiological traits, nervous system variations, distinct communication cultures, neurobiologically driven proxemic needs, and specific professional motivations.
2. The empirical field data proved that the gender-based variance in proxemic distance is closely linked to amygdala neuronal activity and hormonal parameters,

with female journalists preferring closer personal zones (75%) and male journalists operating in formal social zones (75%) [8, 9]. Media managers when assembling creative editorial teams should systematically account for these specific psychophysiological profiles.

3. The documented 40% rate of severe occupational burnout and emotional exhaustion constitutes a primary threat to institutional stability, accelerating personnel turnover and degrading professional motivation.
4. Practical Recommendations: It is highly recommended that higher education curricula and doctoral research frameworks in journalism systematically integrate advanced courses in communication psychology, media sociology, cognitive neuroscience, and proxemics. Additionally, mass media organizations in Karakalpakstan must urgently establish specialized socio-psychological training modules and psychological rehabilitation programs to enhance performance metrics and protect journalists from severe chronic occupational stress.

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Digital Transformation and Sustainable Procurement: Opportunities for Ghana's Manufacturing Sector

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Abstract

The paper was to examine digital transformation and strengthening sustainable procurement within Ghana's manufacturing sector where firms continually face challenges related to supplier readiness, cost constraints and weak enforcement of environmental regulations. Drawing conceptual research designs. The study synthesised literature on digital technologies, sustainable procurement and integrated findings from Ghanaian studies/documents barriers to sustainability adoption. The analysis evidenced digital tools such as e-procurement platforms, blockchain systems, artificial intelligence and traceability technologies offer significant opportunities for improving transparency, supplier evaluation and lifecycle monitoring. These technologies address limitations that historically weakened sustainability performance in Ghana& help firms respond to rising expectations from regulators and customers. The conceptual-framework developed in the study links institutional pressures, organisational capabilities and stakeholder relationships to demonstrate how digital transformation enables sustainable procurement outcomes. The findings indicate practical policy implications that emphasise phased digital adoption, capacity building and stronger regulatory support. Essentially, the study provides foundation for future empirical research, reinforces the importance of digital readiness as strategic requirement for achieving sustainability in manufacturing.

Keywords: Blockchain; E-procurement; Ghana; Institutional pressures; Manufacturing; Slow Digital transformation; Sustainable procurement; Supplier evaluation; Traceability

Introduction

Sustainable procurement has become a central concern in global supply chains as organisations seek to balance economic growth with environmental responsibility and social wellbeing. Today, procurement is no longer viewed as a narrow administrative activity but as a strategic function that can influence competitiveness and legitimacy across industries and this is a view reinforced by scholars such as Walker and Brammer (2009) who emphasise the role of procurement in sustainable development. In many developing economies, manufacturing firms consume significant resources and generate considerable amounts of waste which makes their procurement actions critical to environmental performance. The definition of sustainable procurement offered by ISO 20400 touches on the integration of environmental, social and economic considerations into purchasing decisions as a principle that guides global best practice (ISO, 2017). As expectations for responsible sourcing continue to rise, firms are required to adopt systems

that support transparency and sustainability across their supply chains. Without such systems, sustainability remains an aspiration that is difficult to achieve in practice.

Digital transformation has also emerged as a powerful force that is reshaping the way organisations conduct procurement and manage supplier relationships. Technologies such as artificial intelligence, blockchain, e-procurement and advanced traceability systems offer opportunities for improving efficiency and accountability which are essential for sustainability. The growing importance of digitalisation is recognised in studies that show how information systems enhance monitoring, compliance and decision-making across supply chains (Wilcox et al., 2012). These technologies also support paperless transactions, reduce waste and enable firms to track environmental performance more accurately. Although digital transformation has progressed rapidly in advanced economies, its relevance for developing countries is equally strong as global markets increasingly demand transparency throughout the supply chain. The challenge now is how manufacturing firms in countries like Ghana can take advantage of these technologies to strengthen their sustainability efforts and close existing gaps.

The manufacturing sector in Ghana presents a unique and important context for this conversation. Manufacturing firms operate within supply chains that face challenges related to supplier readiness, environmental compliance and regulatory enforcement, all of which have been documented as barriers to sustainable procurement in Ghana (Dza et al., 2021). Several studies also show that firms misunderstand or partially understand the environmental, economic and social dimensions of sustainable procurement, which further slows adoption (Mensah & Ameyaw, 2012). While some Ghanaian firms have begun adopting e-procurement and paperless systems, the potential of advanced technologies remains largely unexplored. This limited adoption reduces the ability of firms to integrate sustainability into procurement decisions and affects their competitiveness in markets where sustainability and traceability are becoming essential (Issah, 2019). As a result, the sector continues to face gaps in implementation despite growing awareness of sustainability challenges.

There is therefore a strong need to understand how digital transformation can enable sustainable procurement in Ghana's manufacturing sector. Much of the existing research on sustainable procurement in Ghana focuses on regulatory weaknesses, gaps in awareness or challenges in practice without exploring the digital tools that can address these barriers (Adjei-Bamfo & Maloreh-Nyamekye, 2019). Meanwhile, evidence from international literature shows that digital technologies such as blockchain and artificial intelligence can enhance transparency, reduce risk and improve environmental performance although these tools have not yet been examined in-depth within the Ghanaian context (Zaidi et al., 2019). This creates a clear research opportunity for linking digital innovation with sustainable procurement. By identifying how digital tools can enhance traceability, reduce waste and strengthen decision-making, the discussion can provide new insights for advancing sustainability in the sector. Such an examination is timely as firms navigate increasing pressure from customers, regulators and international supply chain partners.

This paper therefore examines the opportunities created by digital transformation for strengthening sustainable procurement within Ghana's manufacturing sector. The aim is to analyse how digital technologies can address existing barriers and support the integration of environmental, economic and social sustainability into procurement

processes. The paper also points out the practical implications for Ghanaian firms and the policy implications for national institutions that seek to promote sustainability across industries. By drawing on evidence from existing studies and aligning them with emerging technological trends, the paper contributes to ongoing debates on sustainable procurement and digital innovation. It also provides a foundation for future empirical research that can test the relationship between digital capabilities and sustainable procurement performance. The sections that follow include a review of the relevant literature, an analysis of the opportunities offered by digital transformation and recommendations for both practice and further study.

Review of Related Literature

This section presents a review of related literature. The review has been organized according to key concepts within the remit of procurement.

Sustainable Procurement: Concepts and Core Principles

Sustainable procurement has evolved into a strategic mechanism for integrating environmental, social and economic considerations into purchasing decisions. ISO 20400 describes sustainable procurement as a process that supports long-term value creation by balancing organisational needs with environmental and social responsibility (ISO, 2017). This broad understanding has shaped global discussions and has encouraged firms to rethink traditional procurement practices that focus only on short-term cost savings. Scholars have shown that sustainable procurement can reduce environmental impacts by improving waste control, energy efficiency and material selection across the supply chain (Ruparathna & Hewage, 2015). In Ghana, the concept has gained attention as manufacturing activities contribute significantly to resource consumption and environmental degradation. Despite its benefits, understanding of sustainable procurement in Ghana varies widely and is often constrained by limited awareness of its environmental, economic and social dimensions (Mensah & Ameyaw, 2012). These limitations make the adoption of sustainable procurement uneven across firms.

Drivers of Sustainable Procurement

Several internal and external factors influence the adoption of sustainable procurement in manufacturing organisations. Internal drivers such as leadership commitment, organisational culture and management support play key roles in guiding sustainability priorities (Feng et al., 2020). External drivers include pressure from customers, government regulations and stakeholder expectations which create incentives for firms to engage in environmentally responsible procurement practices (ISO, 2017). For example, binding environmental regulations have been identified as an important motivator for sustainable procurement in the manufacturing sector as firms seek to comply with national and international standards (Wong et al., 2016). In developing countries, institutional pressures also shape how firms adopt sustainable practices with government agencies playing a dual role as regulators and market participants (Alden & Appleby, 2018). However, scholars note that the strength of these drivers varies and is affected by the maturity of policy frameworks and the capacity of firms to respond effectively. As a result, even strong regulatory expectations may not always lead to consistent implementation in contexts where enforcement is weak (Mensah & Ameyaw, 2012).

Barriers to Sustainable Procurement in Developing Economies

Although sustainable procurement offers clear benefits, its implementation remains challenging for many firms in developing economies. Studies in Ghana have shown that cost implications, limited training and lack of technological capacity are significant

barriers that hinder adoption (Dza et al., 2021). Firms often face constraints related to funding, supplier readiness and the perceived increase in capital costs associated with sustainable alternatives. Weak regulatory enforcement has also been identified as a major limitation as inconsistent monitoring reduces the incentives for firms to comply with sustainability requirements (Issah, 2019). Many suppliers lack the technical and financial resources needed to meet sustainability standards which further complicates procurement decisions for manufacturers who rely heavily on local sourcing. These challenges are compounded by varying interpretations of sustainability which create confusion and limit meaningful action (Mensah & Ameyaw, 2012). As a result, firms continue to struggle to integrate sustainability even when they recognise its value.

Digital Transformation in Supply Chains

Digital transformation refers to the integration of digital technologies into business processes to improve performance, efficiency and decision-making. In supply chain contexts, digital tools enable organisations to track materials, monitor supplier behaviour and improve the visibility of procurement activities. Technologies such as electronic procurement platforms, data analytics and smart monitoring tools have proven effective in streamlining processes and reducing errors (Wilcox et al., 2012). Digitalisation is particularly important for enhancing transparency which is a key pillar of sustainable procurement. It allows firms to maintain accurate records, reduce paperwork and improve communication across supply chain partners. In global markets where transparency and traceability are increasingly demanded, digital transformation has become a strategic necessity rather than an optional enhancement. However, adoption in developing economies remains uneven due to infrastructural limitations and varying levels of technological readiness.

Technologies Supporting Sustainable Procurement

Digital tools offer significant opportunities for strengthening sustainable procurement systems. E-procurement platforms can reduce paper use, enhance compliance and create efficient approval processes that support sustainability objectives (Adjei-Bamfo, 2017). Blockchain technology provides immutable records of transactions which can reduce corruption and build trust in procurement systems, especially in contexts where transparency is a concern (Zaidi et al., 2019). In contemporary times, artificial intelligence offers predictive capabilities that help organisations assess supplier risk, evaluate sustainability performance and identify future trends that may affect supply chain stability. Internet of Things devices can monitor energy consumption, emissions and waste output in real time which allows procurement teams to make informed decisions about environmentally responsible sourcing (Frikha and Mrad, 2025). Traceability systems also support sustainable procurement by following materials across their lifecycle which helps firms comply with environmental laws and stakeholder expectations (Acquaye at al., 2025). These technologies collectively create a foundation for integrating sustainability into procurement by improving information quality and accountability.

The Ghanaian Manufacturing Context

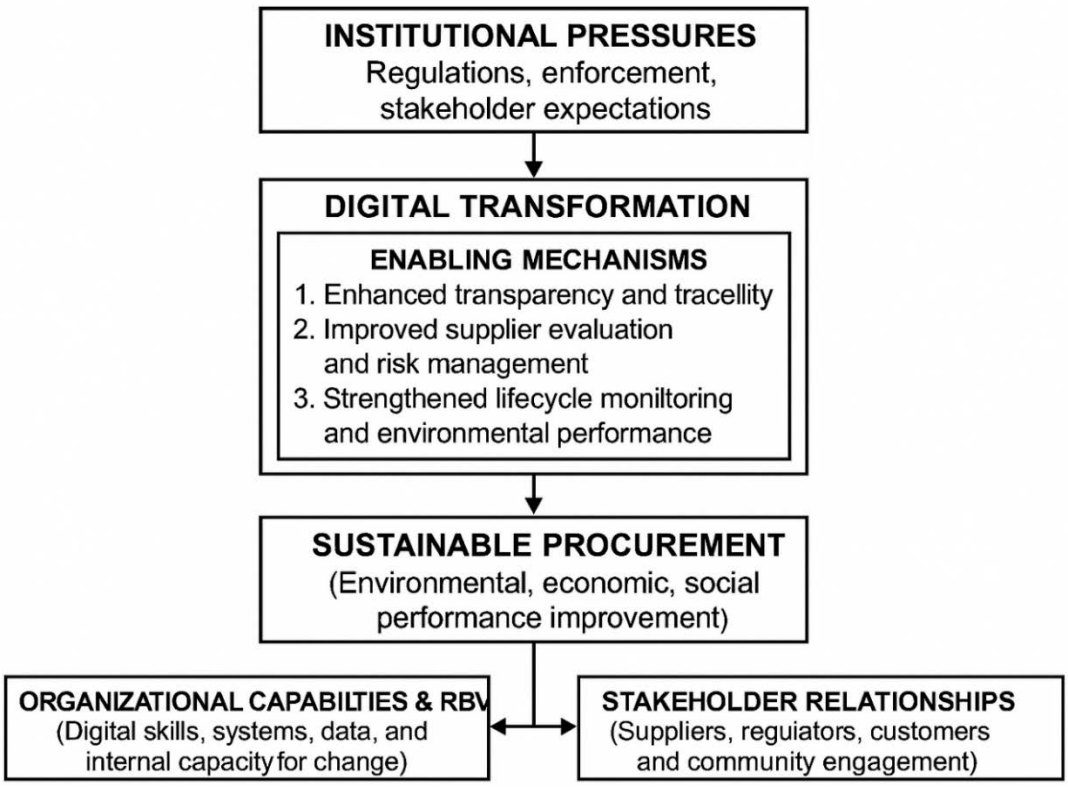
Ghana’s manufacturing sector operates within a complex environment characterised by both opportunities and constraints. Manufacturing firms contribute to national development yet face challenges related to environmental regulation, resource efficiency and waste management. Studies show that many Ghanaian firms do not fully understand the multi-dimensional nature of sustainable procurement which reduces the effectiveness

of their sustainability initiatives (Mensah & Ameyaw, 2012). Regulatory bodies such as the Environmental Protection Agency and Public Procurement Authority play important roles but often struggle with limited enforcement capacity which weakens sustainability outcomes (Issah, 2019). Supplier readiness also remains a significant challenge as many local suppliers lack the skills, resources or motivation to meet sustainability standards (Nsowah, 2023). These issues call for the need for digital tools that can support training, monitoring and compliance across the supply chain. Without such tools, the sector risks falling behind global sustainability expectations.

Gaps in Current Literature

Although global literature increasingly recognises the role of digital technologies in enhancing sustainable procurement, research focused on African manufacturing contexts remains limited. Ghanaian studies have generated relevant discovery into the challenges of sustainable procurement yet rarely explore how digital transformation can address these obstacles (Adjei-Bamfo & Maloreh-Nyamekye, 2019). There is little empirical work linking specific technologies such as blockchain or artificial intelligence with procurement sustainability in manufacturing industries. Much of the existing research also takes a general approach to sustainability without considering the technological enablers needed for long-term transformation. As a result, the relationship between digital capabilities and sustainable procurement performance remains poorly understood in Ghana. This gap presents a strong opportunity for theoretical development and practical recommendations that reflect the realities of firms in resource-constrained environments. Addressing this gap can support stronger policy frameworks and help manufacturing firms adopt sustainability practices more effectively.

Digital Transformation Framework for Sustainable Procurement



Objectives

Interpreting the Framework

The conceptual framework presented in this study illustrates how digital transformation acts as a central driver that strengthens sustainable procurement in Ghana's manufacturing sector. The framework begins with institutional pressures which include regulatory expectations, customer demands and broader stakeholder concerns that encourage firms to adopt more responsible procurement practices. These pressures have been documented in Ghanaian studies that reiterate how environmental regulations and rising stakeholder expectations influence procurement behaviour (Ruparathna & Hewage, 2015; ISO, 2017). However, weak enforcement and inconsistent monitoring often limit the impact of these pressures, which makes digital transformation essential for creating more transparent and accountable systems (Issah, 2019). By positioning institutional pressures at the top of the framework, the model reflects the external environment that shapes procurement decisions before digital tools are introduced. In this way, the framework shows that sustainability does not occur in isolation but emerges from a combination of internal and external influences.

At the centre of the framework is digital transformation which acts as the primary mechanism that enables sustainable procurement. Digital tools such as e-procurement systems, blockchain platforms and traceability technologies improve visibility across supply chains and make sustainability performance easier to measure. These tools help firms overcome barriers such as poor record keeping, unreliable supplier data and limited monitoring of environmental impacts. They also support procurement staff by enhancing decision-making through automation and improved data quality which strengthens overall procurement credibility. The central placement of digital transformation within the framework reflects its strategic importance in addressing challenges that have been identified in Ghana's manufacturing sector. As a result, the framework suggests that digitalisation is not merely supportive but essential for advancing sustainability outcomes.

The framework identifies three enabling mechanisms through which digital transformation influences sustainable procurement. The first mechanism, enhanced transparency and traceability, improves the visibility of procurement transactions and supplier performance which reduces opportunities for non-compliance and strengthens accountability. The second mechanism, improved supplier evaluation, allows firms to assess environmental and social risks more effectively which is important in contexts where supplier readiness remains low (Nsowah, 2023). The third mechanism, strengthened lifecycle monitoring, enables firms to track emissions, waste and resource consumption across production processes which aligns with the recommendations of sustainability scholars who wrote on the importance of lifecycle assessment (Bolton, 2010). These mechanisms operate simultaneously and collectively improve the reliability of procurement decisions. By including them in the framework, the study shows how digital tools translate institutional expectations into practical and measurable outcomes.

The lower section of the framework presents sustainable procurement outcomes which emerge as a result of the enabling mechanisms. These outcomes reflect improvements in environmental stewardship, operational efficiency and long-term value creation which are central to sustainable procurement as defined by ISO 20400 (ISO, 2017). The framework emphasises that digital transformation strengthens the firm's ability to achieve these outcomes by improving access to real-time information and reducing uncertainty in

supplier relationships. This structure demonstrates that sustainable procurement is not an isolated activity but a performance result that depends on the strength of digital processes. Improved outcomes also enhance the firm's reputation and competitiveness which are particularly relevant in industries facing global supply chain scrutiny. The framework therefore links digital innovation directly to measurable improvements in procurement sustainability.

The final components of the framework are organisational capabilities and stakeholder relationships which influence how effectively firms adopt and sustain digital transformation. Organisational capabilities refer to the internal skills, resources and systems that support digital adoption, such as staff expertise, technology infrastructure and data management practices. These elements align with the Resource-Based View which argues that valuable and inimitable resources strengthen firm performance. Stakeholder relationships emphasise the role of suppliers, regulators, customers and communities in shaping sustainability behaviour which reflects perspectives from Stakeholder Theory. Strong digital systems support these relationships by facilitating communication, promoting shared responsibility and encouraging collaborative problem solving. Their inclusion in the framework shows that digital transformation is most effective when supported by both internal capacities and external engagement.

Conclusively, the framework provides a holistic explanation of how digital transformation can strengthen sustainable procurement in Ghana's manufacturing sector. It connects environmental pressures, organisational capacities and technological capabilities to show how firms can overcome barriers that have traditionally undermined sustainability efforts. By interpreting the framework through institutional, resource-based and stakeholder perspectives, the study offers a comprehensive understanding of the mechanisms that influence sustainable procurement performance. The framework also highlights the importance of digital readiness as a strategic requirement for firms operating in increasingly regulated and competitive environments. The model therefore serves as both an analytical tool and a practical guide for firms, policy makers and researchers who aim to advance sustainability through digital innovation.

Methodology

This study adopted a conceptual research design that draws on existing academic literature, policy reports and empirical studies to examine the relationship between digital transformation and sustainable procurement in Ghana's manufacturing sector. Conceptual research is appropriate when a topic requires theoretical integration rather than the collection of new field data, particularly when existing findings present gaps that need to be synthesised and reframed (Xin et al., 2013). Prior studies in Ghana reveal barriers to sustainable procurement related to cost, regulatory weakness and supplier readiness yet offer limited analysis of digital solutions, which makes a conceptual approach suitable for exploring new possibilities (Malik et al., 2024; Etse et al., 2022). This method allowed the paper to connect theoretical perspectives with the practical realities documented in recent sustainability studies. Through this approach, the paper identified patterns across published work and interprets them in a way that offers new insight. The aim was not to measure relationships but to deepen understanding and develop a stronger explanatory basis for future empirical work.

To ensure rigour, the study used a structured literature review process that involved three main stages: identification, evaluation and synthesis. In the identification stage, relevant

peer-reviewed articles, industry publications and policy documents were sourced from academic databases and from the sustainability and procurement literature referenced in the researcher's thesis. The evaluation stage involved examining how each source contributed to understanding sustainable procurement barriers, digital innovation trends and the broader context of manufacturing in Ghana. The synthesis stage then combined these insights to generate a coherent narrative that explains how digital transformation can support sustainability outcomes. This iterative process allowed the study to build a conceptual link between technological tools and sustainability principles. It also ensured that the findings reflected both global developments and local realities.

Although this research did not involve primary data collection, it draws heavily on empirical evidence reported in existing Ghanaian studies. Studies such as Issah (2019), Dza et al. (2021) and Mensah and Ameyaw (2012) provide detailed accounts of the systemic challenges that undermine sustainable procurement. These findings serve as the contextual anchor for evaluating the relevance of digital technologies. The conceptual analysis therefore buildt upon established empirical knowledge rather than replacing them. This strengthens the study's relevance and ensures that its conclusions are grounded in documented practice. It also positions the paper as a bridge between theoretical discussion and future empirical investigation.

Analysis

The limitations of this methodology stem primarily from its conceptual nature. Without primary data, the study cannot measure the actual digital readiness of firms or test the impact of specific technologies in real settings. The conclusions drawn therefore remain exploratory and require validation through case studies, field experiments or quantitative assessments. However, the conceptual approach remains valuable because it indicates gaps in existing knowledge and proposes a foundation for further research. By identifying theoretical linkages and practical opportunities, the study supports the development of richer empirical studies in the future. In this way, the methodology advances understanding while acknowledging the need for continued investigation.

Table 1. Summary of Literature Reviewed.

Author(s) & Year	**Focus of Study**	**Key Contribution to This Paper**
Walker & Brammer (2009)	Sustainable procurement in public sector organisations	Establishes sustainability as a strategic procurement function influencing legitimacy and competitiveness
ISO (2017)	Global guidance on sustainable procurement principles	Defines sustainable procurement and its environmental, social and economic dimensions
Mensah & Ameyaw (2012)	Sustainable procurement awareness and challenges in Ghana	Highlights gaps in understanding and implementation within Ghanaian organisations
Dza et al. (2021)	Barriers to sustainable procurement in developing economies	Identifies cost, training and supplier limitations as major constraints for Ghana

Issah (2019)	Effectiveness of procurement regulations in Ghana	Demonstrates regulatory weakness and enforcement challenges
Adjei-Bamfo (2017)	E-procurement and environmental sustainability	Shows that paperless processes improve efficiency and support sustainability
Adjei-Bamfo & Maloreh-Nyamekye (2019)	Digital tools in sustainable public procurement	Suggests that digital systems enhance transparency and compliance
Zaidi et al. (2019)	Barriers to sustainable procurement adoption	Supports the role of digital technologies in improving traceability and reducing corruption
Wong et al. (2016)	Drivers enabling green procurement	Reinforces the importance of regulatory and institutional forces
Alden & Appleby (2018)	Models for integrating sustainability in procurement	Provides frameworks for embedding sustainability into procurement systems
Feng & Shanthikumar (2022)	Decision-making and systems optimisation	Highlights the analytical value of digital tools for procurement evaluation
Wilcox et al. (2012)	Information systems for supply chain monitoring	Shows how digitalisation enhances monitoring and data accuracy
Krause, Vachon & Klassen (2009)	Sustainable supplier management	Supports the link between supplier performance and sustainability outcomes
Bolton (2016)	Public procurement and innovation	Reinforces lifecycle considerations and sustainability-driven decision making
Etse, McMurray & Muenjohn (2022)	Role of regulation and organisational culture	Explains how governance structures enable sustainability adoption
Nsowah & Phiri (2023)	Supply chain sustainability practices in Ghana	Highlights supplier readiness challenges affecting sustainability progress
Vishwakarma, Patro & Acquaye (2025)	AI for carbon reduction in supply chains	Demonstrates the potential of AI for sustainability and decarbonisation
Frikha & Mrad (2025)	AI-driven supply chain decarbonisation	Shows emerging digital pathways for sustainability innovations

Findings and Discussion

This section discusses the findings that emerged from the synthesis of existing literature and the conceptual framework. It highlights the keyways in which digital transformation can enhance sustainable procurement and address persistent challenges within Ghana's manufacturing sector. The discussion presents these insights through the main themes identified in the review.

Enhanced Transparency and Traceability

Available literature reveals that digital transformation offers significant opportunities for improving transparency within procurement processes which is a key enabler of sustainability. Blockchain technology, digital audits and e-procurement systems create records that cannot be easily altered and therefore reduce opacity in purchasing decisions.

This is particularly important in contexts where weak enforcement of regulations limits compliance and creates inconsistencies in sustainability performance, as observed in Ghana's manufacturing sector (Issah, 2019). When procurement activities are digitised, firms gain clearer visibility of supplier behaviour and environmental risks which strengthens accountability. Enhanced traceability also addresses concerns raised by scholars who argue that firms are now held responsible not only for their own behaviour but also that of their suppliers (Krause et al., 2009). As a result, digital transparency supports a shift from voluntary sustainability practices to more verifiable approaches. This strengthens institutional trust and supports long-term procurement credibility.

Improved Supplier Evaluation and Risk Management

Digital tools provide more reliable ways of assessing supplier performance which is essential for sustainable procurement. Artificial intelligence, data analytics and automated scoring systems enable firms to evaluate suppliers based on environmental, social and economic indicators. This addresses a major barrier identified in Ghanaian studies where suppliers often lack the readiness or capacity to meet sustainability standards (Nsowah, 2023). Digital systems allow firms to detect non-compliance early which reduces the risks associated with poor supplier practices. These tools can also support supplier development by identifying training needs and monitoring progress over time which responds to challenges related to knowledge gaps and limited understanding of sustainability among supply chain actors (Dza et al., 2021). By improving supplier evaluation, digital transformation strengthens the quality of procurement decisions. This creates a more resilient and responsible supply base.

Reduction of Waste Through Paperless Systems

One of the most immediate benefits of digital transformation is the reduction of paper use through e-procurement and automated workflows. Paperless systems reduce administrative waste and minimise errors associated with manual record keeping which supports environmental sustainability objectives. The use of e-procurement platforms has already been recognised as a quick win in Ghana's manufacturing sector because it reduces paper consumption while improving efficiency (Adjei-Bamfo, 2017). This shift aligns with ISO 20400's emphasis on integrating environmental considerations into procurement processes (ISO, 2017). Paperless systems also make it easier to track procurement data which helps firms monitor sustainability indicators. As firms face increasing pressure to demonstrate environmental responsibility, digital processes allow them to show measurable reductions in waste. This contributes to more credible sustainability reporting.

Strengthened Lifecycle Monitoring and Environmental Control

Digital transformation enables firms to monitor environmental performance across the lifecycle of materials and production processes. Internet of Things devices, smart meters and digital traceability tools help organisations track emissions, energy consumption and waste output in real time. This responds directly to calls for more rigorous environmental control within Ghana's manufacturing sector where pollution risks and waste management challenges are widely documented. Firms that are able to monitor their environmental performance more accurately can make better procurement decisions that reflect lifecycle impacts. This approach supports global recommendations that emphasise the importance of assessing environmental consequences from product inception to disposal (Bolton, 2010). Lifecycle monitoring also strengthens compliance with national environmental regulations which have traditionally suffered from weak enforcement

(Issah, 2019). As a result, digital environmental control tools make sustainability more measurable and actionable.

Improved Collaboration Across the Supply Chain

Digital platforms create opportunities for enhanced collaboration among buyers, suppliers, regulators and recyclers which is essential for sustainable procurement. Collaboration has been shown to strengthen legitimacy and resource mobilisation, particularly in environments where internal capabilities are limited (Mensah & Ameyaw, 2012). Digital communication tools and shared platforms make it easier to coordinate sustainability efforts, document responsibilities and facilitate dialogue among stakeholders. This responds to findings that sustainable procurement requires the participation of all actors in the supply chain, including regulators, customers and communities (ISO, 2017). For example, digital platforms can link firms with waste management partners in ways that support recycling and circular economy practices which are becoming more important in Ghana's industrial landscape. Improved collaboration also supports supplier development initiatives by offering shared training resources and performance dashboards. These networks ultimately strengthen the sustainability ecosystem.

Strengthened Regulatory Oversight and Enforcement

Weak enforcement has been repeatedly identified as a major barrier to sustainable procurement in Ghana yet digital transformation provides tools that can support more consistent oversight. When procurement and environmental data are digitised, regulators such as the Environmental Protection Agency and the Public Procurement Authority can monitor compliance more efficiently. Scholars argue that sustainability outcomes depend heavily on the strength of institutional oversight, and this remains an area where Ghana faces persistent challenges (Issah, 2019). Digital records make it more difficult for firms to bypass requirements or hide non-compliance because transactions are visible and verifiable. Enhanced monitoring reduces the dependency on infrequent physical inspections which often leave gaps in enforcement. As a result, digital oversight tools support a regulatory environment that encourages more consistent adoption of sustainable procurement. This reduces the barriers that have historically weakened sustainability efforts across the manufacturing sector.

Strategic Advantage and Competitiveness

Digital transformation offers firms an opportunity to build stronger reputational and competitive advantages through sustainability. Studies show that organisations that adopt sustainability practices attract investors, improve stakeholder confidence and enhance their market image (Belfitt et al., 2011). When digital tools make sustainability more visible and measurable, firms can communicate their performance more effectively to customers and external partners. This creates opportunities in local and international markets where sustainability has become a key purchasing criterion. As firms strengthen their procurement practices, they also reduce operational risks and improve long-term resilience which is critical in an increasingly competitive manufacturing environment. Digital transformation therefore supports both sustainability and business growth. This dual benefit makes it a strategic priority for firms aiming to remain competitive.

Implications of the Findings

Practical Implications for Manufacturing Firms

The findings of these syntheses of literature offer several practical implications for manufacturing firms that aim to strengthen sustainable procurement through digital transformation. Firms must recognise that digital tools are not only efficiency enhancers but strategic enablers that reduce sustainability risks, improve traceability and support more reliable supplier assessment. By adopting e-procurement platforms, digital audit systems and traceability tools, firms can overcome long-standing barriers such as poor record keeping, inconsistent monitoring and limited visibility across the supply chain. These technologies also help firms respond to increasing pressure from customers and regulatory bodies which demand evidence of responsible sourcing and environmental performance (ISO, 2017). Manufacturers are encouraged to invest in capacity building so that procurement officers and supply chain staff can use digital tools effectively and integrate them into day-to-day decision-making. Establishing phased digital adoption strategies will help firms minimise cost burdens while strengthening their sustainability commitments. Ultimately, firms that embrace digital transformation will be better positioned to compete in markets where sustainability is becoming a key determinant of credibility and performance.

Policy Implications for Government and Regulatory Institutions

The findings also hold important implications for policy makers, particularly agencies such as the Environmental Protection Agency and the Public Procurement Authority. Weak enforcement has been identified as a major limitation affecting sustainable procurement in Ghana, yet digital technologies provide new opportunities to strengthen regulatory oversight (Issah, 2019). Policy makers should consider integrating digital monitoring tools into national procurement guidelines and environmental compliance frameworks to improve consistency and transparency. Government institutions can also promote the adoption of digital systems by offering incentives such as tax reliefs, certification schemes and preferential treatment for firms that demonstrate commitment to digital sustainability practices. Investing in national digital infrastructure will further support manufacturing firms that face challenges related to cost and technological readiness. Clear policies on digital procurement will help standardise practices across the sector and encourage suppliers to upgrade their processes. Such interventions will create a more robust sustainability ecosystem that aligns national development goals with international standards.

Implications for Supplier Development and Stakeholder Engagement

The study points out the need for stronger engagement with suppliers who often struggle with readiness, technical capability and understanding of sustainability requirements (Nsowah, 2023). Digital platforms offer opportunities for structured supplier development by facilitating training, sharing compliance requirements and monitoring performance over time. Firms and regulators can use these tools to provide suppliers with clearer guidance which addresses the knowledge and communication gaps documented in previous Ghanaian studies (Dza et al., 2021). Improved digital engagement enhances collaboration and builds trust which is essential for sustainable procurement that relies heavily on multi-stakeholder cooperation. Communities, customers and industry associations can also benefit from digital transparency as it gives them access to verifiable sustainability information. In this way, digital transformation strengthens stakeholder relationships and supports collective responsibility for environmental and social

outcomes. These improvements create conditions for a more inclusive and coordinated approach to sustainability.

Theoretical Implications for Academic Research

The conceptual framework developed in this study provides theoretical implications for the academic community. It demonstrates that digital transformation can be understood not only as a technological shift but also as an institutional and capability-building mechanism that enhances sustainable procurement outcomes. By combining Institutional Theory, the Resource-Based View and Stakeholder Theory, the model offers a more holistic understanding of how digital tools influence procurement behaviour. This integrated perspective responds to gaps in existing literature where the relationship between digital capabilities and sustainability has been underexplored, especially in developing economies. Future research can build on this framework by conducting empirical studies that examine how specific technologies influence procurement outcomes in different organisational contexts. Researchers may also explore sectoral comparisons or longitudinal studies which address calls for broader and more sustained analysis of sustainable procurement practices (Adjei-Bamfo & Maloreh-Nyamekye, 2019). This study therefore lays the foundation for academic inquiry that is aligned with emerging global trends in digital sustainability.

Recommendations

The findings of this study point to several recommendations that can support the integration of digital transformation into sustainable procurement within Ghana's manufacturing sector. First, manufacturing firms should adopt a phased approach to digitalisation by prioritising low-cost tools such as e-procurement platforms before scaling to advanced technologies like blockchain or artificial intelligence. This allows firms to manage cost constraints while gradually building the internal capabilities needed to support more complex systems. Second, firms should invest in continuous training for procurement officers and supply chain staff so they can use digital tools effectively and apply sustainability indicators confidently in decision-making. Training may be done internally or through partnerships with industry associations, universities and digital service providers. Third, firms should collaborate more closely with suppliers by using digital platforms to communicate requirements, track improvements and provide targeted support, especially for suppliers who lack readiness for sustainability compliance. Strengthening supplier involvement will improve overall value chain performance and reduce the risk of excluding smaller suppliers from sustainability initiatives.

Policy makers should also adopt measures that support digital transformation in procurement. Government agencies such as the Environmental Protection Agency and the Public Procurement Authority should integrate digital monitoring systems into enforcement and compliance processes to reduce gaps caused by manual oversight (Issah, 2019). Policy makers may also consider introducing incentive schemes such as tax rebates, preferential procurement scores or certification programmes for firms that demonstrate commitment to digital sustainability practices. Strengthening national digital infrastructure will further support firms that face technological constraints, particularly in areas with poor network coverage or limited access to affordable digital tools. In addition, regulatory bodies should establish updated guidelines that reflect modern digital procurement practices to encourage uniform adoption across the manufacturing sector. Such policy support can accelerate digital readiness while ensuring that sustainability becomes a measurable and accountable requirement. These actions will collectively help

to build a more transparent, competitive and environmentally responsible manufacturing sector in Ghana.

Conclusion

This study concludes that sustainable procurement remains essential for balancing environmental, social and economic goals yet its adoption in Ghana has been limited by supplier unreadiness, cost implications and weak institutional enforcement, as mentioned in earlier studies (Dza et al., 2021; Issah, 2019). Digital transformation helps to mitigate these constraints by improving transparency, enhancing supplier evaluation and supporting more reliable environmental monitoring across the lifecycle of goods and services. Technologies such as e-procurement platforms, blockchain systems and smart monitoring tools make sustainability more measurable and help firms respond more effectively to rising expectations from customers and regulators. These tools also strengthen collaboration among supply chain actors while improving procurement credibility and accountability.

The conceptual framework developed in this study shows that digital transformation works through key mechanisms that are shaped by institutional pressures, organisational capabilities and stakeholder relationships. By integrating Institutional Theory, the Resource-Based View and Stakeholder Theory, the framework presents the ways in which digital technologies can support sustainability even in contexts where enforcement remains inconsistent. The analysis suggests that digital tools create value not only by improving efficiency but by enabling firms to comply more easily with emerging sustainability standards. In this regard, the study contributes to the broader understanding of how developing economies can adopt innovative approaches to sustainable procurement. It also identifies digital readiness as a strategic capability that can enhance competitiveness and resilience within the manufacturing sector.

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The Impact of Social Commerce Marketing Strategies on Purchase Intention: The Mediating Role of Consumer Trust Among Social Commerce Users in China

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Abstract

With the rapid development of the social commerce ecosystem in China, integrated marketing strategies including influencer marketing, live-stream commerce, user-generated content and platform interactivity have become critical drivers of consumer behaviour. However, prior studies often examine such strategies in isolation and lack sufficient explanation of the psychological mechanism linking marketing practices to purchase intention. This study aims to examine the impact of social commerce marketing strategies on purchase intention and to test the mediating role of consumer trust. This study adopts a quantitative cross-sectional design, and data are collected via an online questionnaire from 300 Chinese social commerce users with prior purchase experience. Structural Equation Modeling (SEM) is used to test the measurement model and the structural relationships. The expected findings indicate that social commerce marketing strategies significantly and positively promote consumer trust and purchase intention, and consumer trust mediates the relationship between marketing strategies and purchase intention. This study enriches the theoretical framework of social commerce by integrating the Technology Acceptance Model and Social Influence Theory and provides practical implications for platform operators and marketers to enhance consumer trust and boost sustainable purchase behaviour.

Keywords: Consumer Trust, China, Marketing Strategies, Purchase Intention, Social Commerce

Introduction

The proliferation of social media platforms has transformed the landscape of online commerce by embedding purchasing within socially interactive environments, known as social commerce. Unlike traditional e-commerce, which emphasises transactional efficiency, social commerce leverages peer interaction, user-generated content, and real-time engagement to influence consumer decision-making processes (Zhao, Huang, & Li, 2023). In China, it is particularly advanced due to the integration of social networking, mobile payment, and entertainment within super-apps (Xu & Pratt, 2022).

Recent empirical research shows that influencer marketing, live streaming, and community interactivity significantly affect customer engagement and purchase intention (Busalim, Hollebeek, & Lynn, 2023). Live streaming and influencers enhance trust and purchase likelihood by providing real-time information and social validation (Chen & Yang, 2023), while visible metrics like comments and likes to amplify social influence

(Jia, Lowry, & Liu, 2024). However, studies often examine features in isolation, overlooking their combined effects. Trust, though critical (Wang et al., 2022), is rarely explored as a mediating mechanism. Additionally, much research lacks focus on China, limiting generalisability. This study addresses these gaps by examining integrated strategies and the mediating role of trust in China's social commerce environment.

Review of Related Literature

This chapter presents a comprehensive review of the theoretical and empirical literature relevant to social commerce marketing strategies, consumer trust, and purchase intention. The purpose is to establish a conceptual foundation for understanding how marketing strategies influence consumer purchase intention through the mediating role of trust. By analysing existing research, the chapter highlights key insights and identifies gaps that justify the present study.

Purchase Intention in Social Commerce

Purchase intention refers to a consumer's willingness to buy a product and is a strong predictor of actual behaviour (Ajzen, 1991). In social commerce, purchase intention is shaped by interactive features, social validation, and content credibility. Busalim, Hollebeek, and Lynn (2023) show that interactivity and content quality enhance engagement and increase purchase intention. Similarly, visible social cues such as comments and likes to strengthen social influence (Jia, Liu, & Lowry, 2024). Influencer endorsements and live-stream demonstrations further enhance confidence in decisions (Chen & Yang, 2023), while platform credibility also plays a role (Zhao, Xu, & Xu, 2023).

Social Commerce Marketing Strategies

Social commerce marketing strategies include influencer marketing, live-stream commerce, user-generated content (UGC), and platform interactivity. These strategies rely on social interaction, peer influence, and real-time communication (Leong et al., 2023). Influencer marketing enhances trust and purchase intention through credibility and relatability (Chen & Yang, 2023; Wang & Huang, 2023). Live-stream commerce increases social presence and transparency, influencing trust and buying decisions (Chen & Yang, 2023; Jia et al., 2024). UGC provides credible peer-based information and reduces perceived risk (Busalim et al., 2023). Platform interactivity fosters engagement and relational closeness, supporting behavioural outcomes (Leong et al., 2023). Together, these strategies function as an integrated system shaping consumer perceptions.

Consumer Trust

Consumer trust is a central determinant of behaviour in socially interactive digital environments (Gefen et al., 2003). It includes trust in platform integrity, sellers, and peer-generated content (Zhao, Xu, & Xu, 2023). Trust reduces uncertainty and increases confidence in transactions. Wang et al. (2022) confirm that trust consistently predicts purchase intention. Social and interactive features such as live streams and peer reviews enhance trust by increasing transparency and authenticity (Chen & Yang, 2023; Jia et al., 2024).

Relationships Among Variables

Social commerce marketing strategies influence consumer trust by providing informational cues and social validation. Influencer credibility, real-time interaction, and

peer-generated content all strengthen trust (Wang & Huang, 2023; Busalim et al., 2023). Trust, in turn, directly affects purchase intention by reducing perceived risk (Gefen et al., 2003; Wang et al., 2022). Although strategies also influence purchase intention directly, studies often overlook the psychological mechanism underlying this relationship.

Mediating Role of Consumer Trust

Consumer trust serves as a mediating mechanism linking marketing strategies to purchase intention. Trust translates platform stimuli into behavioural intention (Wang et al., 2022). Empirical studies show that trust mediates relationships between innovation features, influencer credibility, and purchase behaviour (Zhao, Xu, & Xu, 2023; Chen & Yang, 2023). Thus, trust explains how social commerce marketing strategies move consumers from engagement to transaction.

Objectives

Social commerce platforms in China invest heavily in influencer collaborations, live-stream selling, interactive content, and user-generated reviews, yet consumer responses remain inconsistent. Empirical research shows that platform interactivity and social presence enhance engagement (Busalim, Hollebeek, & Lynn, 2023), influencer credibility shapes favourable attitudes (Wang & Huang, 2023), and trust plays an important role (Wang et al., 2022). However, studies examine isolated features, making it difficult to determine how multiple strategies collectively influence purchase intention. The effectiveness of integrated strategies remains unclear because the mediating role of consumer trust has not been sufficiently tested, limiting understanding of how strategies translate into actual purchase intention in China

1. To assess the effect of social commerce marketing strategies on consumer purchase intention.
2. To examine the effect of social commerce marketing strategies on consumer trust.
3. To determine the effect of consumer trust on consumer purchase intention.
4. To test the mediating role of consumer trust in the relationship between social commerce marketing strategies and purchase intention.

Methodology

This study employs a quantitative, cross-sectional research design. A quantitative approach is appropriate because the research seeks to test hypothesised relationships among measurable constructs using statistical analysis. The cross-sectional design allows data to be collected from a large number of respondents at a single point in time, which is suitable for examining perceptions, trust, and purchase intention in social commerce contexts. This design aligns with the analytical framework, where relationships among variables are tested using structured survey data and multivariate statistical techniques

Theoretical Foundation

This study is grounded in the Technology Acceptance Model (Davis, 1989) and Social Influence Theory (Latané, 1981) to explain how technological features and social dynamics influence consumer behaviour. The Technology Acceptance Model posits that perceived usefulness and ease of use shape behavioural intention. In social commerce contexts, features such as interactive content, influencer demonstrations, and live-stream selling enhance perceived usefulness and reduce uncertainty, thereby contributing to the development of trust, a critical determinant of behavioural intention (Wang et al., 2022).
Complementing this, Social Influence Theory explains how individuals' attitudes and behaviours are shaped by peer reviews, influencer endorsements, and community

discussions. These social cues influence perceptions of credibility and reliability, strengthening trust and affecting decision-making (Jia et al., 2024; Zhao et al., 2023).

Analytical Framework
The analytical framework proposes that Social Commerce Marketing Strategies function as the independent variable, Consumer Trust as the mediating variable, and Purchase Intention as the dependent variable. The framework assumes that strategies influence purchase intention both directly and indirectly through trust formation.

Conceptual Model
Social Commerce Marketing Strategies → Consumer Trust → Purchase Intention

Limitations
This study has several limitations. First, it focuses on social commerce users in China, and findings may not be fully generalisable to other countries where digital infrastructure and consumer culture differ. Second, it relies on self-reported data, which may be subject to bias and may not reflect actual behaviour. Third, it examines consumer perceptions rather than platform-generated data. Fourth, the cross-sectional design limits understanding of changes over time. Finally, although trust is central, other psychological factors influencing purchase intention fall outside the scope of the study.

Findings and Discussion

The target population of this study consists of active social commerce users in China. China represents the largest social commerce market globally, with social commerce usage deeply embedded in everyday digital life. Recent industry and market reports indicate that China has over 800 million social media users, a substantial proportion of whom engage in social commerce activities such as product browsing, influencer-led purchasing, and live-stream shopping. Estimates suggest that several hundred million consumers in China have participated in social commerce transactions, making this population both large and highly relevant to the study.

Given the vast size of this population and the absence of a comprehensive public database of all social commerce users, it is not feasible to access every member of the population. Therefore, the study focuses on a representative sample of active users who meet the study criteria. The unit of analysis is the individual consumer. This is appropriate because the study investigates personal perceptions of social commerce marketing strategies, individual levels of trust, and individual purchase intentions. Since the conceptual framework examines psychological and behavioural responses at the consumer level, each respondent represents one unit of analysis.

Sampling Technique
Given the absence of an accessible sampling frame for all social commerce users in China, this study adopts a non-probability purposive sampling technique. Respondents are selected based on specific criteria:

- They must be active users of at least one social commerce platform
- They must have been exposed to influencer marketing, live-stream selling, or user-generated product content
- They must have prior experience purchasing through social commerce platforms

Purposive sampling is justified because the research aims to gather data from individuals who are directly relevant to the phenomenon under investigation. Since the study

examines perceptions of marketing strategies and trust formation, only users with actual platform experience can provide valid responses.

Sample Size

To ensure adequate statistical power for multivariate analysis and mediation testing, the study targets a minimum sample size of 300 respondents. This size is considered appropriate for Structural Equation Modeling (SEM), which requires sufficient observations to estimate multiple relationships simultaneously and assess model fit.

Data Collection Method

Primary data will be collected using a structured online questionnaire. An online survey is appropriate because the target population consists of digital platform users, and it allows efficient access to a geographically dispersed sample. The questionnaire will be distributed through social media groups, online communities, and networks of social commerce users. Participation will be voluntary, and respondents will be informed about the purpose of the study and assured of confidentiality.

Measurement of Variables

All variables in the conceptual framework will be measured using multi-item scales adapted from established studies, ensuring reliability and validity.

- Social Commerce Marketing Strategies will be measured through items reflecting perceptions of influencer marketing, live-stream interaction, user-generated content, and platform interactivity.
- Consumer Trust will be measured using items assessing trust in platform information, sellers, and peer-generated content.
- Purchase Intention will be measured using items capturing the likelihood of buying products through social commerce platforms.

Responses will be recorded on a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree).

Data Analysis Techniques

Data analysis will be conducted using Structural Equation Modeling (SEM), as this technique is suitable for testing complex relationships among latent variables and examining mediation effects.

SEM is appropriate for this study for three reasons:

1. It allows simultaneous testing of multiple relationships between independent, mediating, and dependent variables.
2. It assesses the measurement model (reliability and validity of scales).
3. It enables testing of the mediating role of consumer trust through indirect effect analysis.

The analysis will proceed in two stages:

Measurement Model Assessment

Reliability and validity of constructs will be evaluated using:

- Cronbach’s alpha
- Composite reliability
- Average Variance Extracted (AVE)
- Discriminant validity

Structural Model Assessment

Hypotheses will be tested by examining:

- Path coefficients
- Significance levels
- Coefficient of determination (R^2)
- Mediation analysis using bootstrapping to test indirect effects

Significance

This study contributes to theory and practice by advancing understanding of consumer behaviour within social commerce environments. From a theoretical perspective, it conceptualises marketing strategies as a multidimensional construct and integrates strategic, psychological, and behavioural variables into a comprehensive framework. The inclusion of consumer trust as a mediating variable clarifies the psychological mechanism linking platform strategies to purchase intention (Wang et al., 2022; Zhao, Xu, & Xu, 2023). From a practical standpoint, it provides insights for platform operators and businesses to design effective strategies in China's competitive social commerce environment.

Conclusion

This chapter reviews literature on social commerce marketing strategies, consumer trust, and purchase intention, establishing a conceptual foundation for the study. Purchase intention is shaped by interactive features, social validation, and content credibility, with interactivity and engagement significantly enhancing buying decisions (Busalim, Hollebeek, & Lynn, 2023; Jia, Liu, & Lowry, 2024). Social commerce marketing strategies—including influencer marketing, live-stream commerce, user-generated content, and platform interactivity—rely on peer influence and real-time communication to shape consumer perceptions (Leong et al., 2023). These strategies enhance trust through credibility, transparency, and social proof (Chen & Yang, 2023; Wang & Huang, 2023). Consumer trust, a key determinant in digital environments, reduces uncertainty and predicts purchase intention (Gefen et al., 2003; Wang et al., 2022). The literature highlights that trust mediates the relationship between marketing strategies and purchase intention, explaining how engagement translates into transaction behaviour.

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Low-Cost Online Science Lab on Energy Conversion with a STEM Approach

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Abstract
The limited laboratory facilities in many schools are a challenge in science learning, especially in understanding the physics concept of energy changes. This study aims to describe the description and feasibility of the Low-Cost Online Science Lab with a STEM approach through bold experimental activities and analyze student responses to the learning. This study uses the Mix Method with 29 prospective teacher students and 3 experts as research subjects. The results of the analysis show that a valid and feasible Low-Cost Online Science Lab experimental device has been produced on the concept of changing the potential energy of air into electricity in learning. Based on the results of the initial trial and questionnaire analysis, student responses were on average above 85%, indicating that the acceptance of this learning innovation was in the very good category. In its design, the STEM approach is implemented through the design of learning tools and activities that include the concepts of STEM in an integrated manner. The prototype developed is affordable, easy to use, which is expected to be an effective learning alternative, not only for the concept of Conservation of Energy but also for other science materials. Low-Cost Online Science Labs can provide a solution for schools with limited laboratory facilities, while strengthening the implementation of the STEM approach in education.

Keywords: Conservation of Energy, Learning Aids, Low-Cost Online Science Lab, STEM Approach

Introduction

Understanding the concept of conservation of energy in science education is very important. Currently, there are still many students who have misconceptions related to the conservation of energy. There are still many students who do not understand the concept of energy change. This is because most science learning is only theoretical and lacks observation activities in the laboratory (Swandi et al., 2020). Learning is not made conceptual, not connecting everyday phenomena into learning. On the other hand, a science concept is taught more partially which actually results in misconceptions (Martawijaya, Rahmadhanningsih, et al., 2023).

In addition, there are mistakes in teaching about energy changes. Although the law of conservation of energy states that "Energy cannot be created or destroyed, but energy can be changed from one form to another", teachers are wrong in explaining this concept. They teach as if all the energy from an energy source is completely converted to another system. For example, when teachers teach about the energy produced by hydroelectric power plants, they teach that the potential energy produced by water is the same as the electrical energy produced by the generator. In fact, there is energy lost, which the teacher does not explain at all. Therefore, learning must be done through experiments to prove a physics concept. On the other hand, learning about energy changes is more dominated by theoretical learning in the classroom without providing more contextual explanations based on active learning.

Students' understanding of changes and sources of energy is quite important because this concept plays a very important role in everyday life and the development of science and technology. Understanding how energy can change form, such as from water energy to electrical energy, helps students develop critical thinking and problem-solving skills, especially in facing global challenges related to the energy crisis. This knowledge can also encourage students to be more creative and innovative in creating environmentally friendly renewable energy-based solutions, so that they can contribute to the development of a more sustainable future. Therefore, this concept needs to be taught through various experimental activities.

Review of Related Literature

Laboratory experiments and activities play a vital role in helping students develop a deeper understanding of scientific concepts, acquire practical skills, and engage in the process of scientific inquiry ((Díaz, 2016; Raja et al., 2016). Through direct interaction with physical phenomena, students can better understand the underlying principles, make connections between theory and practice, and foster critical thinking and problem-solving skills (Soh & Meerah, 2013; Szőke, 2022). However, many schools, especially those in areas with limited resources, face the challenge of limited or inadequate physics laboratory facilities (Palloan & Swandi, 2019; Swandi et al., 2020). Although some educational institutions already have some laboratory equipment, it is still very lacking when compared to the number of students. This lack of resources hinders students' ability to engage in direct exploration and deepen their understanding of this basic principle (Kunitsky et al., 2024; Permanasari et al., 2021). In addition, to complete various equipment in the science laboratory, costs are needed, where schools often experience financial limitations (Swandi et al., 2020).

The main objective of this study is to introduce a low-cost online science laboratory as an alternative to the traditional laboratory environment and to integrate the STEM approach into the design of this innovative learning environment (Yaneva, 2022). This approach aims to provide an efficient and cost-effective solution for schools with limited resources, allowing students to continue their scientific exploration and experimentation (Kandil, 2021). An integrated STEM approach has been shown to increase student motivation and make learning science easier (Erickson et al., 2022; Martawijaya, Swandi, et al., 2023; Nedic et al., 2003) and has been shown to improve thinking skills and reduce misconceptions (Martawijaya, Rahmadhanningsih, et al., 2023).

So far, online science learning has been widely carried out using virtual laboratories and has been accessible online. However, not all science concepts have virtual laboratories.

On the other hand, although virtual laboratories can be a solution to overcome the limitations of lab equipment in the laboratory, this learning certainly does not provide a real experience (Nedic et al., 2003). Therefore, it is important to provide real laboratories but can be accessed online by students (Byagathvalli et al., 2019; Erickson et al., 2022). By developing a low-cost online science laboratory that combines STEM approaches, this study seeks to empower teachers and students in resource-constrained settings to engage in meaningful scientific exploration and experimentation (Leineweber, 2020; Szőke, 2022; Yordanov et al., 2023).

This approach not only addresses the problem of limited laboratory facilities but also promotes an integrated understanding of science, technology, engineering, and mathematics (Arumugam et al., 2021; Thatcher et al., 2022). Using a combination of affordable materials, open-source software, and innovative design, these labs aim to be cost-effective solutions that can be replicated and implemented in a variety of educational settings (Afriana et al., 2016; Hofstein & Lunetta, 1982; Permanasari et al., 2021). An integrated STEM approach into the design of a low-cost online science lab will emphasize the interconnectedness of multiple disciplines, encouraging students to develop critical thinking, problem-solving, and interdisciplinary skills (Baudin et al., 2022).

Objectives

By introducing a low-cost online science laboratory and integrating STEM approaches, this study aims to address the challenges faced by schools with limited resources, particularly in the context of physics education. The proposed solution has the potential to increase student engagement, improve learning outcomes, and foster a deeper understanding of scientific principles, which of course can be explored in future research. By addressing the limitations of laboratory learning implementation, this study is expected to contribute to the advancement of science education and empower teachers and students to explore and understand the basic principles of physics in innovative, meaningful and engaging ways. Therefore, the formulation of the problem in this research is:

1. How is the description of the Low-Cost Online Science Lab on Energy Conversion experimental device?
2. How is the feasibility of the Low-Cost Online Science Lab and the STEM approach used in the learning stages?
3. How do students respond to science learning using the Low-Cost Online Science Lab on Energy Conversion?

Methodology

This study uses a Mix Method which is divided into two approaches, namely qualitative and quantitative. The qualitative approach is used to answer the first problem formulation through literature studies from various sources such as physics textbooks, journals on physics experimental tools, and the internet that provides experimental tool components. This study aims to examine concepts related to energy changes and how to develop simple and inexpensive experimental tools. Based on the results of the literature study, the concept and experimental tools that can be developed are determined in the form of Potential Energy Changes into Electrical Energy.

Furthermore, to determine how the feasibility of the Low-Cost Online Science Lab and the STEM approach are applied in learning, it is obtained through a qualitative approach

through discussions with 2 science education lecturers (practitioners) and 1 STEM expert through expert validation and Focus Group Discussion. The feasibility aspects include the design and construction (DC), suitability with STEM (S-STEM), effectiveness in learning (EL), innovation and efficiency (IE). Based on the results of discussions with experts, it is recommended to use project-based learning stages.

While the quantitative approach is used to find out how students respond to the implementation of the Low-Cost Online Science Lab on Energy Conversion through a limited trial. There are 29 prospective elementary school teachers involved in this activity who are divided into 2 groups. 3 students did face-to-face learning and 26 students took online learning. After the learning was completed, they were asked to fill out a questionnaire about the Technology Acceptance Model. The following are the characteristics of student respondents.

Table 1. Characteristics of Student Respondents

Characteritics	Information
Department	Primary Teacher Education
Gender	7 Male, 22 Female
Semester	IV
Average Age	± 20 tahun

Qualitative data is analyzed using content analysis techniques. Content analysis is a technique in qualitative data analysis that is used to systematically understand and interpret the meaning of text data. Qualitative data in the form of text, photos or images, videos, and so on are categorized and given special codes. Previously random data is arranged to be more organized to help researchers understand the data patterns. This makes it easier for the analysis process to obtain clearer information and can be presented in a simpler form. While quantitative data is analyzed by calculating the percentage of respondents' assessments for each item and aspect and then presented in the form of tables or graphs or charts.

Analysis

Description of the Innovation "Low-Cost Online Science Lab"

Based on the results of literature studies from various sources, it was concluded that the concepts and teaching aids developed were related to the change in potential energy of water into electricity that help students understand the basic principles of physics related to changes in energy forms. This tool is designed to show how the potential energy of water at a certain height can be converted into kinetic energy when the water falls and then converted into electrical energy by a generator. The design of laboratory equipment based on simple technology (low-cost) on the concept of energy conversion using easily available materials. In addition to being able to buy energy conversion equipment components directly on the market place, equipment can also be easily obtained using simple materials that are around us. After the teaching aids are assembled, the next step is to combine the use of the tool with digital devices. The accelerometer on the cellphone can be used to determine the rotation speed or simulation application to visualize energy data. The image below is a demonstration tool after assembly:

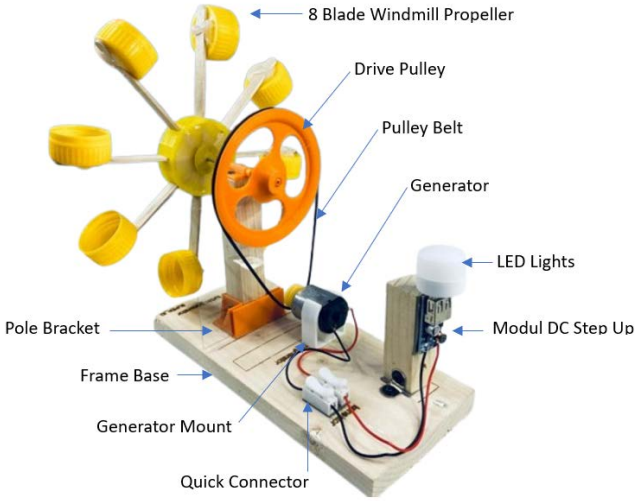

Figure 1. Examples of learning aids that have been assembled

Water is stored in a container placed at a certain height. In this position, water has potential energy that depends on the mass of the water and the height of the water. The higher the position of the water, the greater the potential energy it has. When the valve or water channel is opened, the water begins to fall and flows towards the propeller or turbine. During the journey of the water falling, the potential energy possessed by the water will be converted into kinetic energy due to the acceleration of gravity that affects the water when it falls.

The speed of the falling water depends on the height of the water and the acceleration of gravity. The kinetic energy of the falling water will be used to rotate the propeller or turbine attached to the tool. When water flows and hits the propeller, the thrust from the water flow will rotate the propeller. The kinetic energy obtained from the movement of this water is then transferred to the turbine shaft. This rotating turbine is connected to a generator. When the turbine rotates, the kinetic energy provided by the water flow will move the rotor in the generator. This process utilizes electromagnetic induction, where the movement of the rotor in a magnetic field produces an electric current. The generator converts mechanical energy (rotational motion) into electrical energy.

The electrical energy produced by the generator can be channeled to an energy measuring device, such as a voltmeter or ammeter, to show the amount of power produced. In addition, the electrical energy can also be channeled to run other devices, such as small LED lights, to demonstrate the practical application of the energy produced. This teaching aid allows students to see firsthand the basic principles of the law of conservation of energy and energy conversion. They can observe how the potential energy stored in water can be converted into kinetic energy when the water moves and then converted into electrical energy. Thus, this tool not only teaches theory but also provides practical experience that makes it easier for students to understand physics concepts related to changes in energy forms. This teaching aid can also be adapted to explain various other concepts in science learning, such as energy efficiency, the impact of changes in height on potential energy, and the relationship between mechanical energy and electrical energy. In this way, the teaching aid becomes a very useful medium for teaching STEM concepts in a practical and interesting way.

Feasibility and STEM Components in Learning

The feasibility of Low-Cost Online Science Lab on Energy Conversion is based on the assessment of 3 experts. Expert assessment is divided into two, namely quantitative assessment by scoring each item in the validation sheet and qualitative assessment through suggestions and product improvements. Based on the results of the analysis of the percentage of expert assessments for each aspect is shown in the Figure 2 below

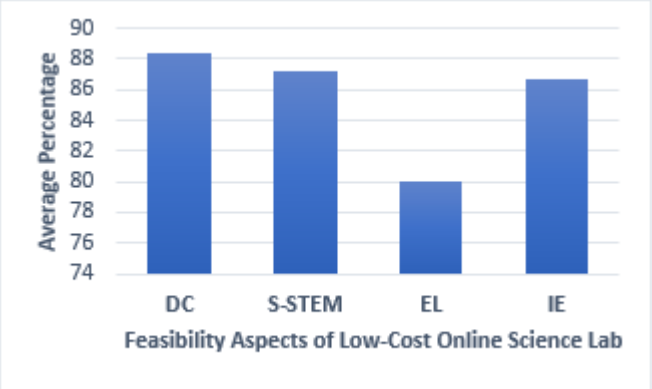

Figure 2. Percentage Score based on Feasibility Aspects of Low-Cost Online Science Lab

Based on the analysis results, the average feasibility score of the Low-Cost Online Science Lab on Energy Conversion was 85.57, which is in the very feasible category. This shows that based on expert assessments, this product is very feasible to be applied in learning. The design and construction (DC) aspects have the highest assessment with an average score of 88.33 (very feasible) and the aspect with the lowest value is effectiveness in learning (EL) with an average score of 80 (feasible).

Findings and Discussion

All experts agree that this experimental tool has strength and durability so that it can be used repeatedly. In addition, the experimental tool is safe to use, easy to assemble and has an attractive appearance. However, some aspects of design and construction, namely the need for protection of the dynamo and electric switch from water splashes. While in terms of suitability with STEM, all experts agree that the experimental tool can be used by integrating STEM interdisciplinary learning. In addition, all STEM components can emerge from the learning process using teaching aids. Then the experts also strongly agree that this teaching aid provides innovation in overcoming the limitations of laboratory equipment and is efficient in terms of using learning time.

However, all experts provide several improvements, especially related to the aspect of effectiveness in learning. This aspect can only be measured after the learning process takes place by providing various measurements before and after the application of online-based experimental tools such as measuring conceptual understanding, misconceptions or various other skills. However, in theory, by looking at the suitability of the experimental tool with the concept of energy change, all experts agree that there will be an increase in student understanding or skills after using this tool in learning. Next, a discussion was held to find out how STEM is integrated into learning. Based on the results of the literature study and discussions with experts, the following are the STEM components in learning taken from several sources.

Table 1. Independent Sample Size Effects.

STEM Components	Definition
Science	Provides a foundation of scientific knowledge about natural phenomena
Technology	Uses technological tools to facilitate learning
Engineering	Focuses on designing and building solutions to real-world problems
Mathematics	Used for data analysis and calculations

Based on the definition of STEM components in the table 1, the following image shows how STEM components appear in learning using the teaching aid

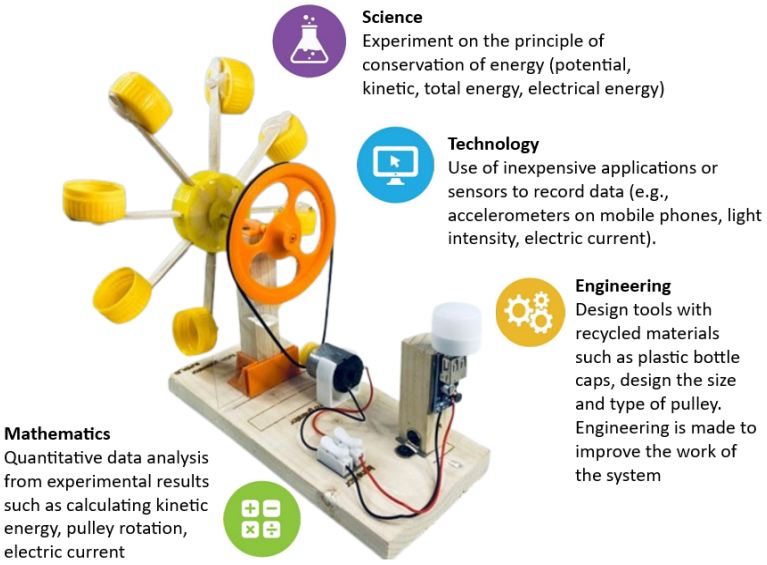

Figure 3. STEM Components in the Experiment Converting Potential Energy to Electrical Energy.

First, students deepen their understanding of concepts (SCIENCE) related to potential energy, kinetic energy and energy changes. The law of conservation of mechanical energy states that in a closed system without the influence of external forces (such as friction or air resistance), the total mechanical energy, which is the sum of kinetic energy and potential energy, will remain constant. The ENGINEERING component appears when students assemble experimental props. To convert the potential energy of water received by the propeller into electrical energy maximally, engineering can be done in several ways. One of them is by optimizing the design of the turbine or propeller that receives the water flow. After the assembly process is complete, TECHNOLOGY components can be operated through the use of technology such as cellphone applications. This application can be used to measure energy by utilizing built-in sensors such as accelerometers and gyroscopes to record movement data, which is then analyzed to calculate energy. The data generated from the experimental process is analyzed using MATHEMATICS components. The potential energy Ep produced by water is converted into electrical energy. By performing mathematical analysis we obtain an equation, we obtain.

In order for learning to be more in-depth, experiments can be conducted several times by varying the control variables and independent variables. In addition to providing quite diverse efficiency values, learning will also be more in-depth where changes in variables

may change the efficiency value which of course can be a step for students to explore and conduct in-depth analysis.

Student Perception of the Learning Process

The innovation in this study is to introduce innovation in science learning using teaching aids integrated with STEM and presented in a online manner in learning. In order for this learning innovation to be carried out, hardware is needed in the form of an action camera connected to a PC, microphone and software in the form of a zoom application. The components of the teaching aids can be obtained through the market place but can also be obtained with easily obtained materials. The installation of teaching aids is not easy. For students who are accustomed to using various work equipment or making crafts, they may find it easier to complete. However, not all students' abilities are the same so teachers need to make clear guidelines on how to install them into a complete teaching aid package.

Figure 4. Students are conducting online testing of experimental props.

In Figure 3, there are 3 students testing the experimental equipment used. They carry out the learning process starting from deepening the concept, design and assembly, experiments, and data analysis. One student uses an action camera attached to his head. The visuals produced by the camera are then transmitted to a laptop connected to the zoom application. So that other students can follow the learning online.

Figure 5. View of the experimental process witnessed by distance students using the Zoom application.

The image above is a display of the experimental process carried out by students. With the help of an action camera, students who are outside the classroom or laboratory can follow all stages of experiment-based learning. In addition to being able to observe all experimental activities, students at a distance can also participate directly by communicating with teachers or other students who are carrying out experimental activities. This makes learning more interactive and provides real experiences for students.

The introduction of the Low-Cost Online Science Lab on Energy Conversion was conducted in a limited classroom where 26 students tried the experimental props without collecting data. After they tried it, they filled out the Technology Acceptance Model questionnaire adopted by the Theory of Reasoned Action (TRA) which is widely used to predict the acceptance and usefulness of technology. This questionnaire contains 17 questions with 5 indicators, namely Perceived Usefulness (PU), Perceived Ease of Use (PEU), Attitude (ATT), Subjective Norm (SN), Behavioral Intention (BI). The results of the student response analysis are presented in the graph below.

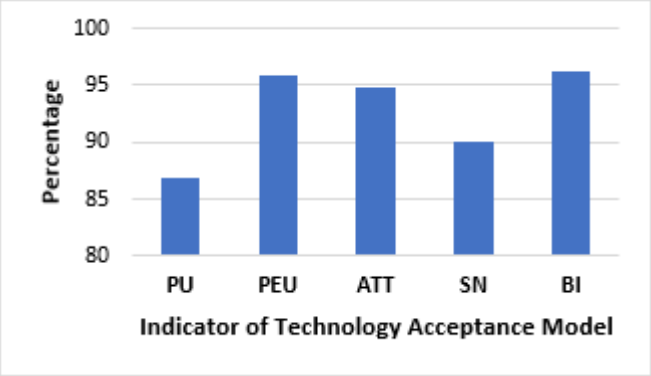

Figure 6. Student responses after limited use of the Low-Cost Science Lab

The results of the Technology Acceptance Model (TAM) analysis of the low-cost online science lab show that the indicators perceived usefulness (PU) and perceived ease of use (PEU) play an important role in shaping users' attitudes (ATT) and their intention to use this technology (BI). The graph shows that PEU and BI have high percentage values, indicating that users find this lab tool easy to use and intend to use it in further learning. Meanwhile, PU has a lower value than other indicators, which may indicate that although this technology is considered useful, there are other factors that may influence the perception of its usefulness, such as limited features or additional needs in supporting complex science experiments. In addition, social norms (SN) also have an influence on the acceptance of this technology, indicating that support from the social environment, such as lecturers and peers, can increase the adoption of the low-cost online science lab. With a high level of acceptance based on the results of this TAM, further development can be focused on improving features and functionality to better suit user needs.

After the trial, students gave some of their opinions regarding the implementation of the low-cost online science lab. Here is a summary of student opinions:

- We were given direct experience in assembling experimental equipment, I think this learning is more interesting and meaningful

- I really enjoy testing the equipment we made directly, we can prove Law of Conservation of Energy that we have studied in theory, without any real activities based on evidence
- The action camera allows us to see the experimental process remotely, but the position of the camera and the unstable movement of the camera make the display on the laptop unstable.
- It is necessary to experiment in a place with good lighting, so that the captured view is clearer.

Implication and Further Research

Through direct interaction with physical phenomena, students can better understand fundamental principles, make connections between theory and practice, and develop critical thinking and problem-solving skills (Šlekienė & Ragulienė, 2013). However, many schools, especially in low-resource areas, face the challenge of limited or inadequate physics laboratory facilities (Evains et al., 2024; Swandi et al., 2020). Lack of access to hands-on learning experiences can hinder the development of essential skills and the overall quality of science education (Corter et al., 2011; Hofstein & Lunetta, 1982). This study introduces the innovation of Low-Cost online Science Lab as an alternative solution to overcome the limited laboratory facilities in schools. By integrating STEM approaches, this online laboratory aims to provide an efficient, affordable, and accessible learning environment for students from various backgrounds (Banky & Blicblau, 2015).

The use of low-cost online science labs in science learning can be based on constructivist theory and Ausubel's meaningful learning theory. Constructivist theory argues that students construct their own understanding through direct experience and interaction with the environment, which in this case is facilitated by online laboratories as a means of independent exploration. By conducting virtual experiments, observing phenomena, and testing hypotheses, students engage in inquiry-based learning that helps deepen their understanding. Meanwhile, Ausubel's meaningful learning theory emphasizes the importance of prior knowledge in understanding new concepts, where online laboratories allow students to relate the material being studied to previous experiences. Thus, the use of low-cost online science labs is not only a solution to the limitations of physical laboratory facilities but can also increase student engagement in the learning process and strengthen their conceptual understanding through exploratory and contextual experiences.

The implications of this study are to provide opportunities for schools with limited resources to implement experiment-based learning and motivate teachers to adopt creative and innovative STEM approaches (Banky & Blicblau, 2015; Doucette et al., 2020). By providing an affordable and accessible laboratory solution, this research has the potential to increase student engagement, improve learning outcomes, and foster a deeper understanding of scientific principles, particularly the conservation of energy concept (Šlekienė & Ragulienė, 2013).

Overall, this research developed a Low-Cost online Science Lab that integrates STEM approaches to provide an engaging and affordable learning experience for students, especially in resource-limited settings. By addressing the limitations of traditional laboratories, this research is expected to contribute to the advancement of science

education and empower both teachers and students to explore and understand fundamental principles of physics, such as the conservation of energy concept.

The implementation of the learning stages of online science learning can be done in subsequent research. This aims to determine whether the syntax is appropriate and what improvements can be made. The development of similar tools also needs to be done for other physics concepts so that it has a wider impact on science learning. Then the provision of practical guidance for teachers in assembling and using this tool in the classroom as well as supporting learning devices such as student work and various measuring instruments to determine the effectiveness of this innovation is also interesting to study further. In addition, this innovation can also be developed into a science learning model that can later be widely replicated in science learning at various levels of education. Experimental research can also be conducted to determine how effective the implementation of Low Cost Online Science Lab is in influencing students' understanding of concepts, misconceptions, and various thinking skills.

Conclusion

Based on the results of this study, it can be concluded that the Low-Cost online Science Lab can be an innovative alternative for learning the concept of conservation of energy and become a reference for learning science in other concepts. This is a solution in presenting inexpensive experimental-based learning equipment that can be used by many students. In addition, this innovation has succeeded in integrating the STEM approach in the design of cost-effective, relevant, and easy-to-implement tools through research-based learning that is carried out in a online manner. Although this study is still limited to the introduction of ideas and initial testing of the equipment used, further research is needed to see how this innovation affects the mastery of concepts and various 21st century skills more broadly.

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An Efficient Use of Mass Communication on the Preservation of China's Intangible Cultural Heritage

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Abstract

Mass communication media had an essential role in educating young people and helping them develop a sense of identity to preserve China's cultural history. Traditional cultural practices can be represented digitally to achieve wider audience attention and boost interaction with increased participation. Nonetheless, there was limited empirical research highlighting the effect of mass communication on the preservation of intangible cultural heritage (ICH) in China. Therefore, this study aimed to investigate how mass media affects China's ICH preservation. The present research employed a cross-sectional and a quantitative study design to gather data. Purposive sampling was utilised in this study to select 649 journalism professors and students from colleges in China. Survey questionnaires were employed to collect data. Additionally, the researcher conducted an Analysis of Variance (ANOVA) to identify the relationship between identified research variables and descriptive analysis approach to examine the fundamental patterns of the data. The findings indicated that mass communication sustains the improvement and preservation of intangible cultural treasures by changing them from a static tradition into an interactive, participatory understanding that reverberates with modern audiences. Mass communication strategies have evolved through innovative integration and digital promotion to provide long-term preservation. This research shows that the relevance of mass communication will be significant for bridging the intergenerational differences in the conservation of heritage.

Keywords: Cultural Promotion, Intangible Cultural Heritage, Heritage Preservation, Mass Communication

Introduction

ICH is a rudimentary component of human civilisation. It represents the perpetual cultural impression and an awareness of generations. ICH presently encounters distinctive problems and prospects with the progression of globalisation. The preservation of ICH has emerged as a global concern in the era of rapid urbanisation. The significance of ICH is established not only in the cultural expression itself but also in the abundance of understandings and expertise conveyed through it over the ages. ICH illustrates a country's historical narrative and the collaborative knowledge of its individuals. Its presence demonstrates that historical aspects transcend mere artefacts in museums, and the personification of old wisdom is not exclusively conveyed through material standards. A significant part of the cultural essence resides in these legacies, as well as augmenting worldwide cultural diversity (Pu et al., 2023). China is a nation with an enriching diverse cultural legacy. The safeguarding of China's ICH holds an important role in fostering national identity. China's ICH law delineates it as diverse conventional cultural indications and associated tangible artefacts

and sites transmitted and esteemed as integral components of cultural heritage by individuals of all ethnicities. These encompass traditional oral literature, art and calligraphy. ICH furthermore encircles acrobatics to standard craftsmanship, medicine, and folklore. Consequently, ICH is a valuable asset of human civilisation and a strong association between chronology and the prospect. It especially signifies ethnic diversification and human ingenuity. Although immaterial, it is profoundly ingrained in community and in-person existence via behaviours, experiences and talents. These cultural resources illuminate the knowledge and understandings of ages, demonstrating significant vibrancy and vigour in their traditional communication (Pan & Guo, 2023).

The emergence of mass media substantially mitigates the challenges posed by diminished acknowledgement and the probable loss of intangible cultural assets resulting from prior informational inaccuracies and inadequate marketing. Documenting ICH is assisted by media platforms including radio, television, and digital networks. These customs can be preserved in both visual and auditory media through documentaries, interviews, and live recordings. These media platforms support in preventing their eventual extinction. Future generations will also have access to authentic depictions of their cultural heritage through the protection efforts of mass communication. Public awareness and engagement are significantly boosted by social media and online media platforms (Jiang, 2024). Mass communication expands the accessibility and appeal of cultural heritage for younger generations by disseminating stories, movies, and interactive content. This greater awareness promotes engagement and interest in customs that help to contribute to their survival. These media transcend the temporal and spatial constraints of conventional media and allow users to access and share pertinent data at any time and from any location, while profoundly engaging with the distinctive allure of ICH. The interactive feature of modern mass media encourages consumers to represent themselves willingly on online sites to get more specific data and effectively handle critical concerns such as misinformation and personalised service requirements (Du & Chen, 2026). The economic sustainability of cultural heritage is helped by mass communication. It makes it possible for cultural practitioners to make a living by bringing traditional crafts and performances to a larger audience. This financial incentive enables performers and artists to keep honing and teaching their craft. Mass media can be strategically employed by the government and cultural institutions to carry out heritage preservation policies and campaigns (Liu, 2022). Practical media strategies strengthen attention and encourage cultural transmission. This stimulates the enduring preservation of China's distinctive cultural origin.

Review of Related Literature

Respective researchers have investigated the way mass communication enables the transmission of cultural practices and increases support across national boundaries for international preservation efforts. A study conducted by Hu et al. (2024) underscored the significance of intellectual property rights to maintain the evolution of ICH research in China. They focused on bibliometric evaluation and expertise mapping methods for the protection of ICH and outlined important study directions among notable authors and the collaboration network. They accentuated the perspectives of the legal structure for protecting cultural resources by increasing academic emphasis. The study demonstrated that traditional knowledge and cultural manifestations were protected by the implementation of intellectual property rights. The outcomes of the research underlined the need for robust policy integration and interdisciplinary approaches to improve the conservation and sustainable use of intangible cultural resources (Hu et al., 2024).

Previous empirical studies had highlighted the importance of Chinese porcelain inlay considered a significant asset of China's ICH. Li and Chen (2025) studied widespread perceptions of the ICH of Chinese porcelain inlay through a research of data acquired from social media platforms. The researchers employed data-driven methods to analyse audience engagement and emotional responses to this ancient craft in digital contexts. The study emphasised principal themes in user-generated content. The study included aesthetic appreciation of cultural symbolism and national identity. The outcomes revealed that social media significantly influences modern cultural understanding by transforming traditional heritage into publicly available and engaging information. Online comments demonstrated appreciation for the excellent craftsmanship of Porcelain inlay and increasing awareness of historical and cultural significance. The study showed that there are differences in perspectives among diverse user groups. The research also signified that social media has become a crucial platform for promoting culture and engagement among people. However, the study explored the difficulties of external participation and the commercialisation of culture. It emphasised the importance of digital communication strategies to safeguard and develop cultural assets in the modern era (Li & Chen, 2025). Moreover, Wei and Xin (2024) stated that the impact of advancements in technology helps to preserve and grow the intangible cultural sources. The study explained that the emerging importance of technologies has helped in documenting and preserving traditional cultural activities. The researchers showed that technology has the capability to distribute the cultural assets by developing audience engagement. Moreover, the digital tools helped to elevate the reach of education to more people. The study underscored that technology encourages innovation by allowing practices that adhere to the modern context to preserve relevance. The research identified the difficulties as well, which are caused by the technological adaptation. It is observed from the study that it delivered important aspects to develop sustainable heritage and careful integration to preserve and innovate (Wei & Xin, 2024).

Several previous studies determined that online platforms have influenced the protection of ICH. Zihao (2022) investigated the influence of recent media technological approaches on the conservation and transmission of ICH. The study highlighted that digital platforms have revolutionised established ways of cultural transmission into more interactive and accessible formats. Younger generations' engagement has increased due to new media. Their active participation had improved cultural awareness. The investigation showed that the incorporation of multimedia approaches helped to preserve endangered practices by documenting customs in dynamic audio-visual formats. The risk of cultural exploitation and the deterioration of authenticity as a result of excessive digital adaptation were highlighted in the study. The study scrutinised the way new media significantly contributed to the preservation and regeneration of ICH. Maintaining cultural integrity while embracing technical advancements demanded a balanced approach (Zihao, 2022). Additionally, He and Wen (2024) analysed Chinese ICH crafts. The study underscored the use of digital technology to improve traditional craft production and distribution. The study showed the way digital transformation allowed crafters to maintain traditional skills while adapting them to the demands of the contemporary market. Digital media improved ICH's market accessibility and worldwide visibility. The study encountered issues with maintaining authenticity during the digital transition and technological capability. According to the research, the sustainability of ICH craft for both cultural preservation and commercial viability in the current digital era depended on a methodical digital development approach (He & Wen, 2024). A study by Cen et al. (2024) investigated the way Chinese digital platforms helped disseminate Cantonese opera to adolescent audiences. The digital content encouraged participation and active interaction. Classic opera is now more approachable

and captivating for younger audiences through these technological capabilities. The study underlined the way community-focused conversations and short videos increased cultural understanding and interest. It also emphasised the importance of platform algorithms and content customisation to engage targeted consumers. However, there was evidence of content simplification and potential loss of normal depth. According to the study, Chinese digital media platforms significantly revitalised Cantonese opera by bridging the continuous broadcast of ICH (Cen et al., 2024).

Social Learning Theory by Bandura and Walters (1977) asserted that humans acquire behaviours, attitudes, and values through observation, imitation, and modelling. The idea underscored the significance of cognitive processes, reinforcement, and social environment, proposing that individuals can learn new actions by observing others, particularly through media and symbolic representations (Bandura &Walters, 1977). Prior research investigated the knowledge-transmitting intents in the digitisation of rural ICH resources through theoretical frameworks. The research indicated that external cues and internal perceptions affected users' propensity to share knowledge. The study underscored the significance of trust, reciprocity, and digital engagement in preserving ICH (Zhang & Zhang, 2025). Prior research predominantly concentrated on digital technology, social media involvement, intellectual property safeguarding, and audience views in the preservation of China's ICH. Nevertheless, a limited study has investigated the collective impact of mass communication on public awareness, cultural learning, and behavioural intentions regarding ICH preservation from the standpoint of Social Learning Theory within the Chinese setting.

Objectives

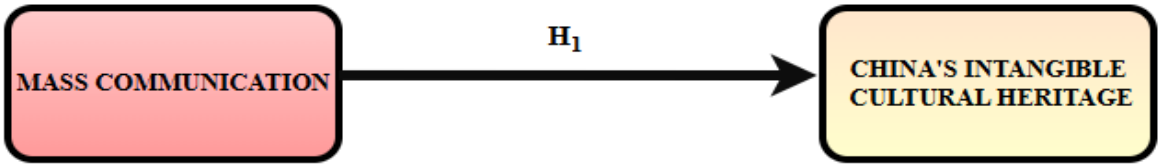
To examine the efficient use of mass communication in preserving China’s intangible cultural heritage.

Methodology

Research Design and Procedure

A quantitative, cross-sectional study design was utilised in the current research to explore how mass communication contributed to the preservation of China's ICH. The design allowed for the collection of data from respondents at a specific moment in time to quantify patterns and consider the connection between the research variables and their identified factors. Suitable responders obtained an online structured questionnaire, which was used to gather data. The survey instrument was developed as part of the study process using the variables that had been identified. While Cronbach's Alpha was included for reliability evaluation, a pilot test was used to confirm validity. Additionally, the administration of the structured questionnaire to the chosen sample and statistical analysis using SPSS version 25 assisted in identifying quantifiable correlations between promotion and the preservation results of ICH. The magnitude and direction of the statistical relationship were ascertained within the confidence interval at 95%. The statistical significance threshold was established at a p-value < 0.05. While the data was assessed employing ANOVA, the researcher utilised descriptive analysis to identify the core features of the data.

Operational Framework



Subjects or Data Source

A survey was conducted to collect primary data for the research. Professors and journalism students at Chinese universities provided data, as they had expertise in media discourse and mass communication methodologies. The survey comprised two sections: (a) demographic data of the respondents, and (b) statements evaluated on a 5-point Likert scale to assess perceptions of the significance of mass communication in protecting ICH.

Instrumentation and Data Analysis

The present research used a purposive sampling technique to select valid and relevant study respondents in the research context. Raosoft tool recommended 613 research participants for the data collection for the study. Therefore, 750 survey questionnaires were distributed to the respondents. 723 questionnaires were returned to the researchers, from which 74 questionnaires were discarded because of inappropriate or incomplete responses. Therefore, the final sample size was 649. Statistical analysis was completed using Microsoft Excel along with SPSS 25 for the research investigation. The researcher applied a descriptive analysis technique to recognise the essential components of the data, while ANOVA was utilised to help evaluate the data acquired.

Limitations

The research was subject to several limitations that are intrinsic to quantitative research. Due to the fact that respondents were less likely to provide comprehensive explanations in response to closed-ended survey questions, it may be more challenging to capture intricate cultural meanings or contextual factors that have an effect on the preservation of cultural property. There is a possibility that quantitative data will oversimplify the complex promotion of ICH protection. Furthermore, generalising the findings may prove challenging, as the data obtained from a limited cohort of university participants in China may not accurately represent the entire nation, as connections were assessed solely once, instead of throughout multiple distinct time intervals. When utilising a cross-sectional technique, it could be more difficult to demonstrate that there is a causal relationship, because the findings would be contingent on the demographics of the respondents, in addition to their cultural understanding and patterns of media exposure.

Analysis

Factor Analysis

The objective of Factor Analysis (FA) is to determine previously unrecognised constituents via publicly accessible data. The Kaiser-Meyer-Olkin (KMO) test evaluates sample adequacy, determining the appropriateness of data for FA based on variable correlations. The principal objective of this investigation is to ascertain any evident correlations, vulnerabilities, or breaches. The results indicate that both the hypothetical model and its randomly selected parameters yield reliable estimates. The potential for discovering duplicate data entries exists. The data is more comprehensible when the proportions are

simplified. KMO presents a numerical value to the researcher, ranging from 0 to 1. The KMO value, ranging from 0.8 to 1, determines an adequate number of samples.

Kaiser delineates the following requirements: Kaiser stated that the subsequent needs were satisfied: The average is 60-069; hence, the range of 0.050 to 0.059 is significantly lower. The intermediate ground grades generally span from 0.70 to 0.79. Exhibiting a quality point score between 0.80 and 0.89.

The interval from 0.90 to 1.00 astounds them.

Table 1: Examination of KMO and Bartlett's Sampling Adequacy
According to the KMO scale: 0.852
The results of Bartlett's test of Sphericity are as follows:
Approx. chi-square = 4650.234
190 is degrees of freedom (df); sig = 0.000.

Table 1. KMO and Bartlett's Test

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.852
Bartlett's Test of Sphericity	**Approx. Chi-Square**	4650.234
	df	190
	Sig.	0.000

The researcher employed Bartlett's Sphericity Test to analyse statistical significance in the correlation matrices. A sample size was considered enough when the KMO score reached 0.852. The outcomes of Bartlett's Test of Sphericity indicate a p-value of 0.00. Henceforth, it was reasonable to infer that the correlation matrix is not an identity matrix based on the favourable outcomes of Bartlett's Test of Sphericity.

Independent Variable
Mass communication
Mass communication is represented as the efficient diffusion of information to a broad audience and is a complex phenomenon. Its utilisation has profoundly influenced society. Mass media moulds cultural practices and values. It often involves individuals' perceptions and interactions with the world. It propagates novel concepts and ideologies that influence its viewers' purchasing behaviours, preferences and well-being. Content creators in mass media possess the authority to configure public discourse by deciding which issues are considered paramount and which issues garner any attention. Mass communication denotes the media that encompass communication, including radio, television, and mobile devices. Mass communication appears in diverse representations and provides multiple intents. It helps in public education and furthermore assists in political campaign advancement. Mass media play an essential role in entertainment delivery. It can broadcast information rapidly beyond the initial source. Multidisciplinary experts possessing a comprehensive knowledge of the procedure can utilise it to engage with a wide range of consumers. Mass communication acts

as a key mechanism for societal connection and evolution. Comprehension is crucial for individuals seeking to persuade, inform, or inspire within media (Jaguessar, 2022).

Dependent variable

China’s intangible cultural heritage

ICH is a fundamental element of China's remarkable conventional cultural community. It exemplifies the ongoing transmission of Chinese civilisation and serves as an important fundamental for cultivating national sentiment and preserving national unity. They emphasise the significance of ICH in sustaining historical lineage and enhancing cultural self-assurance. They promote exchanges and mutual comprehension among civilisations and construct a resilient socialist cultural nation. ICH embraces activities and knowledge systems as well as abilities inherited through generations, such as oral traditions, traditional craftsmanship, and an understanding of nature. These cultural features are entrenched in local communities and are perpetually reconstituted in reaction to evolving social and environmental circumstances. The safeguarding of China’s ICH has evolved increasingly crucial due to the substantial dangers posed by fast modernity and globalisation to its preservation. The Chinese government has instituted extensive protective measures concerning documentation and incorporation into modern cultural spheres (Zhang et al., 2024).

Relationship between mass communication and China’s intangible cultural heritage:

The extensive integration of fresh technologies and modern mass media has rendered the digital distribution of ICH increasingly prevalent and retained. Contemporary digital platforms have revolutionised social communications and data distribution by creating novel cultural interaction channels and structures. The digital protection initiative for Chinese ICH substantially enhances cultural promotion and the preservation of ancient customs (Li, 2022). The proficient utilisation of mass communication can provide economic and cultural benefits to ICH practitioners while also improving the sustainability of these practices. It can reach broader and more diverse audiences beyond its origin via mass communication methods. Media platforms record and preserve endangered traditions and ensure their transfer to future generations. Televised cultural programs and digital storytelling initiatives showcase traditional practices accessible and appealing to younger audiences. Social media platforms enable interactive engagement and allow communities to exchange, reinterpret and preserve their heritages in modern circumstances. Furthermore, mass communication enriches public awareness and develops cultural pride. Integrating ICH into mainstream media narratives boosts its visibility and societal value. Simultaneously, it promotes cultural tourism and economic advancement by highlighting distinctive cultural resources (Qiu, 2023).

The researcher has developed a hypothesis to assess the relationship between mass communication and China's intangible cultural heritage, considering the previous discussion:

“H01: There is no significant relationship between mass communication and China’s intangible cultural heritage.”

“H1: There is a significant relationship between mass communication and China’s intangible cultural heritage.”

Table 2: H1 ANOVA Test

ANOVA					
Sum					
	Sum of Squares	**df**	**Mean Square**	**F**	**Sig.**
Between Groups	93,646. 239	220	8440.239	1151.779	0.000
Within Groups	727.634	428	7.328		
Total	94,373.873	648			

This investigation produced important insights. Considering the F-value (1151.779) and p-value (0.000) are below 0.05, statistical significance has been determined. The results specified that the alternative hypothesis, "H1: There is a significant relationship between mass communication and China's intangible cultural heritage", was accepted and the null hypothesis was rejected.

The study demonstrated a robust and statistically significant connection between mass communication and the preservation of China's ICH. The dataset was appropriate for FA. It was demonstrated by a KMO value of 0.852, signifying adequate sampling. Bartlett's Sphericity Test indicated that the research variables were adequately connected and appropriate for further statistical analysis. The ANOVA test results indicated a highly significant conclusion, a distinct p-value below 0.05 and a value of F of 1151.779. The findings demonstrated that the alternative hypothesis was accepted while the null hypothesis was rejected. This determined that mass communication has an essential role in the preservation of ICH. The significant F-value reinforced the strength of the connections between research variables, confirming the reliability and robustness of the analytical model.

Findings and Discussion

The study findings underscored that mass communication approaches were crucial for the conservation and advancement of China's ICH. The findings of the study demonstrated that several mass media platforms, including digital and social media, significantly enhanced general understanding and involvement. Contemporary mass communication techniques also had a substantial function in the integration of cultural traditions. The results indicated that mass communication was not only an ancillary tool but also a concentrated effect impacting the sustainability of ICH. The integration of modern communication technologies has changed traditional cultural presentations into participatory and convenient designs, improving their effectiveness among younger individuals. This evolution blended with previous investigations that emphasised the importance of digital circulation in overcoming geographical and worldly barriers. The research confirmed that mass media improved the financial viability of cultural conventions by presenting more significant visibility to artisans and performers, authorising them to provide accessibility to more extensive audiences. Moreover, the results demonstrated that media-oriented cultural advertisement developed an intention of cultural individuality and dignity among people. The communicative elements of contemporary media facilitate residents to energetically encounter in the conservation and reconfiguration of their inheritance within recent frameworks. However, the discourse acknowledged that reliance on quantitative techniques might have deprived the depth of cultural understanding, as complex cultural implications could not be completely encapsulated by solely numerical information. The research demonstrated that mass communication greatly and thoroughly affected the conservation of China's ICH. It successfully pinnacles generational dividends. Mass

communication improved cultural communication and ensured the continuance of traditional activities in an advanced digitalised society.

Conclusion

The study determined that mass media played an essential role in maintaining China's ICH. Digital media and social media platforms have improved knowledge and participation with conventional cultural approaches. The study also demonstrated that the incorporation of mass communication technologies transformed conventional cultural presentations into engaged, communicative, and participatory backgrounds. This modification made the cultural inheritance more available to younger people. The research emphasised that mass media combine standard understanding with contemporary digitalised platforms. The study concluded that mass communication enhanced the financial sustainability of cultural actions by improving the visibility of artisans and entertainers. This divulgence developed options for cultural practitioners to maintain their livelihoods while safeguarding and communicating their chronology. Media improvement has been honoured to improve cultural dignity and a profound knowledge of history among people and communities. The findings strongly affirmed the significant association between mass communication and the protection of ICH. The research confirmed that mass communication is a powerful and efficient tool in protecting ICH. It enabled the transmission of conventional understanding and improved cultural involvement by reinforcing the significance of heritage in an increasingly digitalised world.

The study's findings may significantly impact academic organisations and media professionals with substantial responsibility in disseminating cultural information. Incorporating heritage-related content into media curricula and advocating for participatory communication strategies helps improve cultural understanding among younger generations. This may foster a sense of cultural identity and continuity while promoting active engagement in preservation efforts. Furthermore, the study will demonstrate that cultural practitioners and artisans can attain economic benefits through the strategic utilisation of mass media by acquiring insights from the research. Media exposure for cultural promotion can create new market prospects. It may improve sustainable livelihoods and promote the conservation of traditional skills. This has additional ramifications for cultural tourism and creative industries. The results indicated that more investigation could shed light on environmental dynamics and deeper cultural connotations. A more in-depth understanding of the association between mass media and historic cultural preservation may be obtained by broadening the scope beyond limited sample sizes.

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Digital Pen and Global Voice of Youth: I am Malala as Cross-Cultural Communication Discourse

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Abstract

The transformation of education in the age of artificial intelligence is not merely a technical upgrade; it is a moral imperative to promote peace, diversity and fundamental human rights. "Education is neither Eastern nor Western it is human" and global peaceful weapon in the fight against terrorism within Women, Peace and Security (WPS) agenda promised by UN Security Council Resolution 1325 as a security imperative of peacebuilding. The denial to the fundamental right of education for girls is gender-based intellectual violence related to other forms of physical, psychological and verbal violence for erasure of feminine identity, intellectual pursuit, and professional aspiration. There is no peace without inclusion of women in the architecture of future because the hands that rock the cradle is also the hands that codes the representation of voice in the age of artificial intelligence resonates through every server and every soul. Malala Yousufzai is the Pakistani Youngest Nobel Peace Prize Laureate in the history at the age of seventeen. She belongs to era of Web 2.0 in which she used the digital pen of social media platform to fight for education as a fundamental right declared by UDHR, UNICEF AND UNISECO in the world. The gendered autobiography I Am Malala: The Girl Who Stood for Education and was Shot by the Taliban is a tribute to the world, humanity and English Literature as a cross-cultural communication of the language, history, culture, and struggle of Pakistani origin Pashtun descent author Malala Yousufzai. The research is qualitative in approach employing the theoretical framework of Johan Galtung's theory of Violence and Peace to identify the factors responsible for gender apartheid and how Malala used the voice of defiance to dismantle the narrative of oppression.

Keywords: Education, Gender Apartheid, Oppression, Peace, Violence, Voice Representation

Introduction

History has witnessed that heavy prices have been paid by the martyrs of peace to execute the truth: intellectual, philosophical and religious information to reach the masses. Truth is not the commodity to be licensed or silenced or muted by the tyrants of time but a biological and spiritual necessity; a testament to the fact that human conscience is an unlicensed force. The individuals who challenged the ideological dogmas were seen as a threatening force to the power structures: Empires, Church, and States. Authorities like religious, political and monarchical used extreme measures to curb or to suppress intellectuals who challenged the status quo. Throughout history during periods of intense

religious and political conflicts individuals who denied the key dogmas or established order and authority through their observation fell victims to execution, burning at stake (immolation), exile, imprisonment, systematic banning and burning of books to control information with charges of heresy/political defiance and traitors. The key figures of history who rebelled are Socrates (399 BC), Thomas Beckett (1170), St. Joan of Arc (1415), William Tyndale (1536), Nicholas Copernicus (1543), Michael Servetus (1553), Thomas More (1535), Giordano Bruno (1600), Galileo Galilei (1633), Antoine Lavoisier (1794), Rosa Luxemburg (1919), and Nikolai Vavilov (1940) etc.

The motives behind banning or licensing of books is a form of censorship to suppress the freedom of opinion, expression and speech in annals of history due to the power that literature holds in shaping societal values and beliefs. The literature and books have been always identification for a nation. Historically books have been burnt in times of conflict such as the burning of books and live burial of 460 Confucian scholars in 213 BCE were ordered by Chinese emperor Qin Shi Huang to eliminate criticism and consolidate power. The destruction of one of the most significant libraries of ancient world is library of Alexandria in 48 BCE by Julius Caesar is a significant loss to ancient knowledge. In the Nazi campaign during 1930s over 25000 books were burned across Germany deemed to destroy un-German literature. The destruction of the Vatican Library and Archives in between 1797-1813 under Napoleon Bonapart was s systematic seizure and removal of historical records. The US. Library of Congress was burned during war in 1814 by British troops that destroyed 3000 volumes.

When intellects are executed and books are burned the goal is to destroy both the nation's identity and intellectual freedom. History always lived in national imagination which indicates how deeply the memory of war and peace penetrate into national consciousness because the effects of war and peace translated into words which bear witness to pain and pleasure. The literature becomes evidence of resistance and resilience related to conflicts as per environment to bring about societal cohesion to give voice to impulses of peacebuilding. John Milton's book Areopagitica is one of the most famous defenses of free speech against Licensing Order of 1643. He stated, "A good book is the precious life-blood of a master spirit, embalmed and treasured up on purpose to a life beyond life… who kills a man kills a reasonable creature, God's image; but he who destroys good book, kills reason itself, kills the image of God" (2016). It is a universal fact that mortals die but executing a thinker is a crime against humanity but above all killing a book means destroying knowledge, truth and reason produced by author. The reasons and beauty stored in a book are the vessels that have the potential to make knowledge, and truth immortal through perfection of art across ages as treasures of humanity.

John Keats expressed the reality in Ode to Grecian Urn (1819),

"Heard melodies are sweet, but those unheard

Are sweeter; therefore, ye soft pipes, play on" (2024).

The physical heard voices can be silenced through extreme antagonism, but oppression cannot seize the unheard human spirit longing for fundamental human rights of peace and justice. Percy Bysshe Shelley's The Masque of Anarchy (1819) is the first manifesto of non-violence resistance in pages of English Literature. The powerful cry of poem remained censored for 13 years by the state under the Blasphemous and Seditious Libels Act until publication in 1832. The Peterloo Massacre stands as one the most brutal example of direct violence in the history of British democracy used to curb a peaceful global voice of 60,000 citizens for demand of vote. Following the public outcry over deaths at Peterloo the British government led by Lord Liverpool and Lord Castlereagh

passed The Six Acts (1819) including the Training Prevention Act (targeted organization of youth), the Seizure of Arms Act (invasion of privacy), the Misdemeanor Act (imprisonment of truth-teller), the Seditious Meeting Act (required license on global voice of gathering), the Blasphemous and Seditious Libels Act (penalties of writing who critiqued the state or church), the Newspaper Stamp Duties Act (economic censorship). The Six Acts were part of literal and legal curb of Structural Violence to dismantle power of social networking: pen and voice to ensure that people should not assemble to speak again. P. B. Shelley writes that,

Rise like Lions after Slumber
In unvanquishable number
Shake your chains to earth like dew
Which in sleep had fallen on you
Ye are many-they are few (2015).

In the age of Web 2.0 revolt the 'Digital Pen' is held by humanist universal figures like Malala Yousufzai who represents the 'Modern Lion' of the global youth waking up to the chains of oppression. She is global education activist, U.N. Youngest Messenger of Peace (2014) and the Youngest Nobel Peace Prize recipient in history of world at age of 17. As a most powerful global symbol of courage and hope she is fighting for a world where every girl can learn and choose her future.

The gap between the Age of the Stake (Bruno and Galileo) to the Age of Press (Milton and Shelley) is filled up by the Age of Internet of Things (Malala). In the web 2.0 era the 13 years gap of censored poem has shrunk to 13 milliseconds. Yet the direct violence (bullet) and structural violence (pamphlets, and algorithms) remain identical to the tools used against icons of history. The age of Internet of Things (IoT) has triggered the rapid advancement of communication technologies through cyber-physical systems that have advanced and enhanced aspects of living facilitating communication across the world. In this context, the transmission of information to every nook and cranny becomes very easy and practically accessible. The environments where physical constraints prevent direct communication the digital tools become essential and reliable way of communication as a voice transmitter. The 'Digital Pen' is a direct descendent of the physical pens of martyrs and the current struggle of information control in 2026 is a continuation of the age-old battle between human rights to peace and the tyrant's need for censorship to hold power. The medium has mutated from inks to bits the essence of the voice and intent of pen remained constant. Whether passing through a telescope to a pamphlet to blog the 'Realms of Gold' used the same psychological frequency to broadcast truth against abuse of power. The imperialism of information tried to categorize the individuals by technology but the voice that demands peace, and freedom remains universal human constants. Pope Leo Francis XIV promoted interfaith peace and asserted in Cameroon that, "The world is being ravaged by a handful of tyrants, yet it is held together by the multitude of supportive brothers and sisters…onto a sustainable path rich in human fraternity. There is no catholic peace. There is no Islamic peace. Peace is human. Blessed are the peacemakers! But woe to those who manipulate religion and the very name of God for their own military, economic, and political gain, dragging that which is sacred into darkness and filth" (Purdy 2026).

Pope Leo's XIV discourse served as theological seal to the legacy of Malala Yousufzai who acclaimed factual endorsement of humanization of peace and fundamental rights for all without discrimination as the youngest Nobel Peace Prize Laureate (2017) in the world. She stripped the sectarian and gendered-based boundaries for peace asserted

education as cross-cultural discourse having no geographic license, "Education is neither Eastern nor Western, it is Human" (2013). The cross-cultural discourse is the study of exchange of ideas, values, beliefs, and narratives between cultural groups of different nations. In this context the marginalized or local voices transcends geographical and ideological boundaries to create shared universal human experience of truth. The cross-cultural discourse of Malala Yousufzai; I Am Malala (2013) is the triumphant survival of legacy of global voices of resistance for peace and freedom entitled as, "I Am Malala: The Girl Who Stood up for Education and was Shot by the Taliban". The interconnectivity proves cross-cultural defiance towards cross-cultural humanism to resist Eastern extremism of the Taliban regime: Shot but not silenced. Therefore, I Am Malala can truly be called as the 'Modern Areopagitica' ink-stained with the blood of those who refused to be silenced. Her discourse creates the universal shared conscience where the youth of the west emphasized upon the 'Right to Know': EDUCATION is a human moral necessity and fundamental right in the Universal Declaration of Human Rights (Article 26) defined at international platforms of UNO, UNESCO and UNICEF. The Article 26 of the Universal Declaration of Human Rights (1948) states, "The right to life and dignity of an individual cannot be assured unless it is accompanied by the right to education" (2015). Malala Yousufzai was born and brought up in the Mingora city of Swat valley of Pakistan called as the Switzerland of Pakistan. Her autobiography I Am Malala narrates how a local school going Pashtun girl becomes globally recognized and identified and how a personal story becomes international public myth. I Am Malala is not merely a 'Pakistani' narrative (Pashtun origin) of non-violent resistance to seek education, but the text bridges the gap of English Literature to Global South. By writing in English, she performs an act of reclaiming, reestablishing and retelling the truth to both Eastern and Western stereotypes. Her memoir I Am Malala serves as a fascinating real world case study in transcultural communication. By writing in English: global lingua franca about Pashtun taboos, social structures and culture she created a bridge between the local realities of the Swat valley of Khyber Pakhtunkhwa province in Pakistan and global audience of international community. She weaves in English the 'Pashtunwali' concepts and flavours of her heritage rich with poetry and hospitality 'Melmastia' to be known throughout world. Her evolution from a local schoolgirl to global activism of peace and education illustrates transcultural journey. By adopting the language and frameworks of global community Malala did not just report the local problem of denial of education to girls but she elevated her non-violent resistance to a 'Universal Holy Grail' something worth her sacrifice as she survived the assassination attempt at age of 15: sacred, ultimate quest of dignity for womanhood.

Review of Related Literature

Her autobiography I Am Malala as a cross-cultural communication ensures that the Pashtun struggle for education is not viewed as a foreign problem but as a shared human endeavor with a long lineage of international legal battles and civil uprising. She proclaimed in Speech at United Nations, "This is the legacy of change I inherited from Martin Luther King, Nelson Mandela and Muhammad Ali Jinnah" (2013). Therefore, this is the same struggle as the Civil Rights Movement (1940-1960) in America claimed for equality in the days of Jim Crow Laws which maintained to keep the segregation between whites and Blacks in housing, transportation, education, public places and on jobs. The Brown vs. Board of Education became first global commandment of education, 'Separate is inherently Unequal' (1954). The chief justice Earl Warren delivered a unanimous decision that admissions must be universal without considering race under 14th

Amendment's Equal Protection Clause of America. The fight against inequality and injustice focused on racial segregation in America is the same fight of 'Gender-Apartheid' in Swat valley of Pakistan: deliberate systematic attempt to erasure of women from public and private life by denial of their basic human rights primarily right to education as a crime against humanity. She expressed in her global address with her speech at the United Nations Assembly (2015), "We must ensure that no girl should left behind". In her memoir Finding My Way (2025) she addressed the global crisis of gender apartheid adopted the language of global policy and Agenda for Sustainable Development of 2030 as, "Every girl deserves the chance to be in school. No girl should be left behind". In 2021 US. Congress passed the Malala Yousufzai Scholarship Act legally enshrining her name to the US education framework as an ultimate act of cross-cultural communication becoming the part of American Public Law.

The connection between the Soweto Uprising in South Africa and Malala's struggle is the ultimate testament of Nelson Mandela's 'Young Lions' stepping into vacuum of leadership to defend their right to think. Nelson Mandela in 1990 stated, "I pay tribute to the endless heroism of youth, you, the Young Lions. You, the young lions have energized our entire struggle" (2011). In 1976 thousands of Black South African students marched against Bantu Education Act (1953) which forced them to learn in Afrikaans (language of oppressor). The architect of the Act Hendrik Verwoerd created a hedge for Blacks so that they could never compete to modern world, "What is the use of teaching the Bantu child mathematics when it cannot use it in practice?... There is no place for him in European community above the level of certain forms of labour" (1953). The peaceful protestors met state sponsored violence and the dying image of youth; Hector Pieterson became Malala Moment of 21st century. Malala in her memoir I Am Malala writes about how her father Ziauddin filled their home with stories of global heroes and she mentions Mandela is one of them. She notes that Mandela spent 27 years in prison to claim equality as she was fighting for Swat valley. She writes in I Am Malala, "I wanted to be as tall as him (Mandela) when I stood up for my girls" (2013). By invoking Mandela as a transcultural link in memoir, she was signalling to the world that Taliban's ban on girl's education was just another form of apartheid that required 'Soweto Style' youth uprising to break the chains. Therefore, Malala embodies the Lion archetype in the cross-cultural context refusing to let her mind be caged. Malala took up this call proving in I Am Malala, "One pen, one book and one child can change the world" (2013).

The abduction of 276 schoolgirls from Government Girls Secondary School Boko Haram in 2014 and the Chibok 2.0 incident of kidnapping 110 schoolgirls from the Government Girls Science and Technical College in Dapchi in 2018 run parallel to the survival of Malala in same brand of extremism. In her memoir I Am Malala, the destruction of girl's schools is the central theme of part 'Valley of Death' in which she describes the systematic campaign of fear and terror through verbal, psychological and physical tactics of Taliban led by Maulana Fazlullah (the Radio Mullah) who kept environment of surveillance through FM broadcast. She writes, "I was just ten when more than 400 schools were destroyed. Women were flogged. People were killed. And our beautiful dreams were turned into nightmares. Education went from being a right to being a crime". Just as the abduction of girls in Nigeria was a strategic weapon to destroy education in Nigeria, Taliban destroyed the infrastructure of schools in Swat valley that is how she linked trauma of Pashtun girls with Nigerian girls showing that extremism follows the same pattern everywhere. She visited Nigeria in 2014, 2017 and 2023 which serves as a bridge to borderless quest for education as a symbol to global anti-apartheid movement.

Her organization The Malala Fund Legacy invested $6.1 million since 2014 to promote education to girls in Nigeria. She stated, "I can see those girls as my sisters". She writes in her autobiography I Am Malala, "They thought that bullets would silence us, but they failed. And out of silence came thousands of voices. In the face of violence truth cannot be destroyed" (2013).

As a cross-cultural message to the world through UN speech she stated, "You cannot have peace talks in Afghanistan or Nigeria if half the population of girls is illiterate" (2015). In I Am Malala she describes the importance of 'Admission Doctrine' and school 'Register' as a legal document of identification as a social contract. The school register is the place where a girl's name is recorded outside home in private sphere and Taliban blew up the school records to erase girl's existence practicing a form of social assassination. She stated, "Taliban blowing up our books and our school registers…they wanted to wipe out our history and future in one go" (2013). When the girl's names are removed from history they were pushed back to 'Separate Sphere Theory' where girl has no public names and rights imparting them second class citizenship. The aim is to justify the male dominance over womanhood attributing them gender communal traits like dependent, passives, non-decision makers, emotional, muted or silenced ones. A society that excludes and oppresses women justifying its aims through 'Patriarchal Culture' further entrenched by Taliban regime cannot achieve true peace through gender gap. Gender inequality denied girls their identification based on intellectual pursuit, political participation and professional aspiration. I Am Malala depicted literal and metaphorical curfews on minds and bodies of women in Swat valley. She explained how patriarchal culture intensified by Taliban oppression when severe restrictions and curfews are enforced on female movements and they were not allowed to travel without male escort. "Taliban imposed a permanent curfew. We were told to stay inside. To be invisible. Our presence on street was treated as crime" (2013). The law of oppression imprisoned women and their abilities to work, shop and seek education and medical care. She stated, "Our world was getting smaller. It was a house then a room. We were like birds in a cage" (2013). The problem became more severe when militant extremist violence banned girls right to go to schools and prevented 50,000 girls from schools. The parents who violated Taliban laws defying their orders and sending their daughters to schools' severe punishment publicly inflicted to them like whipping.

After the incident of September 9/11, the war on terror transformed women's rights to global security pillar through Women, Peace and Security (WPS) Agenda as a strategic necessity for world peace into a single cross-cultural narrative. Laura Bush stated that, "Fight against terrorism is also a fight for rights and dignity of women" (Jessica 2019). The agenda is codified in UN Resolution 2242/2015 and 1325/2000 which established the essential rights of Protection, Participation, Prevention and Relief and Recovery for women around globe. Malala acted as the WPS personified functional agency and acted as bridge between the pillars of essential rights from Right of Protection to Relief and Recovery for women across the world. She influenced the international global catalyst for the Safe Schools Agreement (2015) in conflict zones to prevent schools from violent extremism. In 2026 She has redefined gender apartheid system not merely as human rights violation but a primary security threat to international peace and security. Recently in March 2026 Malala outspoken for Minab school bombing following Tomahawk missiles strike on Shajareh Tayyebeh Girls' Primary school in Iran in which 170 innocent girls aged from 5 to 14 were martyred. The strike physically vaporized the records of Minab girls under the rubble of history and views schools as collateral rather than

sovereign territory just like Malala describes the Swat valley destruction in, I Am Malala, "They are blasting the schools every day because they were and they are afraid of change and equality that we will bring to our society" (2013). On Women's International Day she addressed, "I am devastated for families in Iran whose daughters left for school and did not return home…True justice does not defend the humanity of children in one place and ignore it another…why justice is not wide enough to reach girls in Minab, Jabalia, or Kandahar?... true justice does not claim our rights are dependent on where we are born or what is politically safe?" (2026). Malala is using Minab incident to push for the codification of global demand if a girl at desk is not safe from missile in her classroom no one is truly sovereign in the world: no difference who hate education (Taliban) and those who claim Pax Americana (Global Super Power). Through WPS Agenda she is demanding a world where a girl at Global South is secured and protected as equally treated as under international law of CAH Treaty (Crimes Against Humanity Treaty) just like a girl at Global North. Malala has shifted the narratives of WPS agenda globally to the framework of 'Negative Peace and Positive Peace': Justice is the prerequisite for peace. She stated at the United Nations Speech in 2013, "I speak not for myself but for all girls and boys. I raise up my voice…so that those without voices can be heard" (2013).

Following are research objectives

To document the cross-cultural appeal of Malala's narrative, *I Am Malala* as a practical bridge of historical struggles for the right of education for girls.

To explore the power of digital pen and global voice of youth challenging the structural violence of gender apartheid to restore positive peace in *I Am Malala.*

Research Questions

Following are research questions

In what ways does the cross-cultural appeal of Malala's narrative, *I Am Malala* serve as a practical bridge of historical struggles for the right of education of girls?

How does the synergy between the digital pen and global voice of youth challenge the structural violence of gender apartheid to restore positive peace in *I Am Malala*?

Methodology

Conceptual Framework and Methodology

The research is qualitative in approach and document analysis of I Am Malala. Through Malala's framework, education is a grand unified theory of human progress. She synthesized different ages into transcultural matrix as follows:

1. Education is ultimate act of national sovereignty and intellectual self-determination she learnt from Muhammad Ali Jinnah and Nelson Mandela. She argues that, "pen is mightier than sword" (2013).
2. Education is the legal battle for unrestricted access to equality she learnt from the participation of Martin Luther King in the Civil Rights Movement. She demands "12 years of free, safe and quality education" in justice cannot be selective demands (2026).
3. Education is inherent necessity therefore the gates of education 'Admission Doctrine' must be open to all in humanitarian protected zone that prevents the radicalization that fuels global terror. She learns from Women, Peace and Security (WPS) Agenda that safety is prerequisite for peace and stability for women.

Education is a social contract to sovereignty (Right to Learn), equality (Right to Access) and stability (Right to Safety).

Findings and Discussion

Digital Pen of Youth

Voice is an internal realization and outward expression of individual's reality in the world. Voice without action is just verbalism but voice with action becomes activism and a person becomes agent of change to protest for fundamental rights. In the annals of history there is an interconnectivity between voice, education and liberation of nations. Historically education is a weapon to liberation: liberation of mind and body. It is an instrument by which younger generation integrate into logic of social, political, and economic contradictions to deal critically and creatively as per environment to participate in transformation of their world so that they will be no longer spectator of history but author of history themselves. The world history records that the voice of intellects is stolen continuously by the umbrella terms tyrant agencies such as Racism, Colonialism, Nazism, Patriarchy and Talibanization. The central paradox of their oppression collectively is to occupy the minds of the people: to accept and to internalize the image of oppressor. Oppression turns people from subjects to objects: things to be used, directed and dictated by external force. Human beings that are defined, named and interpreted by others. Therefore, Oppressed population are stripped of their fundamental rights and forced to live in 'Culture of Silence' because they have no conscious mind: they see the world through eyes of oppressor. Paulo Freire in his monumental work Pedagogy of Oppressed (1968) expressed, "For the oppressors, 'human beings' refers only to themselves; other people are 'things'". The relationship between oppressor and oppressed is defined by the struggle of (de)humanization between them. I Am Malala is gendered autobiography of Malala Yousufzai in which she narrates her real-life journey of 'becoming' through truth claim representation of reality: journey from local actor to global activist to international author. Her autobiography functions as public utterance of personal trauma to live under constant fear and terror proving truth cannot be silenced under extreme antagonism of assassination attack. Her narratives transformed the ultimate act of oppression of patriarchy and Taliban violence into local and then global voice of youth to seek fundamental rights. In Malala's world Taliban acted as ultimate oppressors by monopolizing truth and forbidden dialogue controlling the lives of people as objects. "We realize the importance of our voice when we are silenced. In the same way we realized the importance of pens and books when we saw the guns" (2013).

Education reveals a person that world is not a given reality but a historical one and internalized chains can be dismantled. Paulo Freire in literary work Pedagogy of Oppressed (1968) stated, "Education is the practice of freedom; as opposed to education as a practice of domination: man is abstract, isolated, passive, and unattached to the world. To exist, humanly is to name the world, to change it". The Taliban's ban on female's education is a classic example of Freirean tactic to prevent the oppressed from 'naming the world': most powerful act of being about power, ownership, and transformation. If an individual cannot name the reality (injustice, inequality, violation of fundamental rights like theft of education) in which she/he lives they will always live like spectators in a world created by others. In Malala's context snatching away the right of education is an act of female erasure of identification in both public and private lives. She recognizes the problem and named it as, "Taliban could take our pens and our books, but they couldn't stop our minds from thinking" (2013). She names their rule as, 'Jahalin' (ignorance), "Taliban are not a faith; they are group of men who want to keep us in dark" (2013). For

Malala internet (web 2.0) was her dictionary and vocabulary. The Taliban called the Burqa (physical concealment) as modesty and mandatory for females to wear outside home but Malala renames it as physical and mental cage. “It is like a walk-in-jail... I chose to keep my face uncovered. I wanted to be Malala, not a girl hidden in shuttlecock burqa” (2013).

No one can give voice to oppressed they must seize it through shared struggle for social change. It is an ultimate act of courage and resilience against systemic antagonism of oppressor forces. The process of unchaining or mind-liberation or breaking the deafness of silence starts when the oppressed says ‘NO’ to the force to stop behaving them as master to slaves. The oppressed person becomes an agent of change through moral awakening realizing themselves as historical beings who have power of voice to influence and change history. The act of coming to voice is a revolutionary shift to exist in the world an act of healing. It is a bridge between a being as a ‘thing of unheard’ to a person who acts accordingly and reaches ‘self-actualization’ phase. Bell Hooks in her monumental work Talking Back: Thinking Feminist, Thinking Black (1989) pointed out, “Moving from silence to speech is for the oppressed, the colonized, the exploited…a gesture of defiance that heals, that makes new life and new growth possible…when we dare to speak in a liberatory voice…we participate in a global struggle to end domination” (1999). At the age of 11 she wrote a BLOG to BBC Urdu named, “Diary of a Pakistani Schoolgirl” in 2009 under the name Gul Makai. She dictated BBC reporter over the phone call and her voice transformed into digital text that shifted her from object to subject of history. She used the blog to document the crimes on global stage as Global Crisis of Human Rights. It was the birth of her voice (critical consciousness), “I began to see that pen and words that come from it much more powerful than machine guns” (2013). Her voice got attention of international audience and picked by The New York Times documentary film by Adam Ellick Class Dismissed (2009) which gave her visual and vocal force unchaining her thoughts from local silence to global stage. When Taliban issued the ban on girl’s education completely by January 2009 her decision to be filmed was her ‘NO’ to ‘Culture of Silence’ bypassing Taliban’s blockade of information by a series of deliberate media appearances. Another film by the New York Times was A Schoolgirl’s Odyssey (2009) detailing how Taliban turned the lives of citizens of Swat into Internally Displaced Person (IDP). She appeared in monthly interviews on national channels like PTV, Geo TV, AVT from 2009-2011 as a youth of Pakistan who wanted justice and peace. She was attacked in 2012 by Taliban calling her Pro-Western due to continuous social activism. I Am Malala is written in 2013 one year after attack and she transformed from local voice of Gul Makai to global authority of Malala using digital infrastructure to ensure the problem is not local Pakistani issue but a human rights crisis in world, “I was not just a girl anymore; I was a voice of all those who could not speak” (2013).

Digital Clicktivism

Malala Yousufzai use of ‘Digital Clicktivism’ is the emphatic use of online noise converted into collective voice of youth having political weight: a form of modern consciousness. The digital platform mobilizes the youth of web 2.0 to name their own world. Her digital words start with a click and ends with movements of global dialogue for conflict resolution. The Key movements are #BooksNotBullets launched in 2015 and resulted in 3 million petitioners signed for human security than military security. The global movement of Incheon Declaration passed. #TheLast was launched in 2015: aimed at Sustainable Development Goals. In 2018 Assembly digital platform magazine for oppressed to write stories and break the silence.

Global Voice of Youth

Malala Yousufzai's activism is a strategic attempt at Conflict Transformation. Through the world of I Am Malala she deconstructs structural, cultural and direct roots of violence hindering in noble of education. She is a global advocator for transition from Negative Peace to Positive Peace in the world. This section explores the theoretical bridge applying Johan Galtung's theory of Triangle of Violence.

The Anatomy of Violence

In Galtung's framework violence is like an iceberg: Direct is visible tip but it is supported by the massive, submerged weights of Structural and Cultural violence.

Structural Violence

Johan Galtung in Violence, Peace and Peace Research defines Structural Violence as, "It is present when resources are unevenly distributed (education and income) and above all power" (1969). The structural violence is the systemic deprivation that occurs due to social machinery of laws, and customs embedded in social institutions (Patriarchy and Taliban) automatically blocks the goals of one gender (women) to justify dominance of another gender (men). It creates social injustice that prevents individuals from achieving full potential. It is a gap that manifest lack of legal and social identity which creates alienation and erasure of womanhood. In I Am Malala the structural violence refers to gender gap between male and female since birth. The structure of Pashtun patriarchal culture rendered the women as non-entities as they do not exist in the eyes of records. Malala describes the 'Woma Celebrations' which sets the standards of social acceptance and recognition of a boy and girl at birth. "On the seventh day the Woma, there is usually a great feast for a boy, but for girl nothing… When a boy is born in our tradition, it is a cause of great celebration. Guns are fired into the air, and gifts are placed in baby's cot. A boy is a cause of celebration. But when a girl is born no one visits the mother receives sympathy" (2013). The nothingness for a girl is structural norm and standard procedure of Pashtun society to ignore girls. The feast is physical resource symbolic to community support which establishes a hierarchy of potential right of celebrated future for a boy since birth. The Structural violence works by penetrating in taboos pushing one gender to marginalization or exclusion. "There seemed no point in going to school just to end up cooking, cleaning, and bringing up children" (2013).

The structural violence deprives people from meeting basic needs by law and coercion. Johan Galtung defines the Basic Human Needs as, "The term violence is used about avoidable insults to basic human needs…survival needs (negation to death), well-being needs (negation to misery), identity needs (negation to alienation) and freedom needs (negation to repression)" (Cultural Violence 1990). By categorizing Malala's experience through Galtung's four types of needs her struggle is a defense of universal human needs. The violence against 'Survival Needs' in I Am Malala results in death and most obvious layer used by Taliban as verbal threats, public executions, hanging bodies publicly, flogging, whipping, bombing and shooting of Malala is a direct insult to the need of survival. "I started thinking about death. At night I would wait until everyone was asleep…then I'd check every single door and window" (2013). Galtung views education as meta-need because it provides tools to fulfill all other needs. The education gap in I Am Malala is not merely a social disparity but direct insult to 'Well-Being Needs'. By closing schools, the structure ensures that girl's intellectual and mental health is the form of gendered essentialism. "The extremists are afraid of books and pens…the power of

voice frightens them" (2013). The 'Identity Need's provide sense of belonging to land, culture and culture. The violence against identity needs results in alienation as Malala gave the detailed description of how Radio Mullah broadcast to distort the identity of Pashtun women telling them their only identity is domestic and to remain silent, "I am a daughter of Islam…Taliban were not killing people but they are killing our culture" (2013). The 'Freedom Needs' imparts an individual the choice of one's path: freedom of movement, speech and thought. The violence against freedom results in repression, segregation and fragmentation of power gap like women were not allowed to participate in Jirga (councils), "I was a girl in a land where…daughters are hidden away behind a curtain" (2013).

Cultural Violence

Johan Galtung describes the aspect of culture (religion, ideology and language) used to justify the structural and direct violence. He defines as, "Cultural violence makes direct and structural violence look right…it changes the moral color of an act from red/wrong to green/right" (1990). In I Am Malala Taliban bombed 400 schools (direct violence) banned girl's education (structural violence) to convince the community as a religious and moral necessity by using authority of Islam. "He said that if people didn't follow his version of Islam they would go to hell. Girls should stay at home and schools were a western plot" (2013). The cultural violence use language to dehumanize as Malala was seen as a 'traitor' and her father's school was called as 'center of obscenity'. Malala's 'Digital Pen' served as a tool to deconstruct the cultural violence which made oppression feel like piety and misinterpreted Islam. "I am daughter of Islam and I know Islam is religion of peace and humanity" (2013).

Direct Violence

Johan Galtung defines it as, "verbal or physical act that causes harm to body or mind" (1990). In Malala's discourse Direct Violence is the most visceral entry point of a deeper hidden conflict that became global voice. The shooting of Malala is not an isolated incident but a climax of campaign of terror designed to silence the digital pen. She stated as, "The man was wearing a peaked cap and had handkerchief over his nose and mouth… Then he took out Colt 45 and fired three shots. One after another" (2013).

Typology of Peace

Johan Galtung defines two types of peace: Negative and Positive. He defines Negative Peace as "absence of war, direct or physical violence" (2011). It is a state where underlying reasons of conflicts remain rooted. In the text Malala stated, "peace deal was signed…but it was not peace we hoped for…they were still stopping girls to go schools" (2013). Therefore, Malala used 'Digital Pen' of Gul Makai Blog to document 'Negative Peace' to the world that just because the bombed stopped didn't mean the violence ended. She demanded 'Positive Peace' through 'Digital Pen' as a global driver to 'Feminine Empowerment'. Galtung describes Positive peace as, "absence of structural and cultural violence" (2011). The positive peace is not the static state of no war zones but an active process of social justice, equality and restoration of human rights without discrimination for all so that everyone can fulfill basic human needs to full potential. Malala's vision is a vision of positive peace where every girl should go to school.

Malala as Peacebuilder

Muhammad Ali Jinnah; the Founder of Pakistan stated in 1944, "There are two powers in the world; sword and pen…there is third power stronger than both that of women". Malala Yousufzai became the living symbol of Jinnah's philosophy on global cross-cultural stage. In 21st century youth is universal language of cross-cultural communication. Whether in Birmingham, New York, UN stage or Swat valley she proves to be 'Jinnah's third power' shifted the global policy towards UN passed resolution 2250 on Youth, Peace and Security in 2015 which recognized the youths not as victims of war but agents of peace treaties and national security. Malala emerged as global icon of youth as youngest UN Messenger of Peace using 'pen vs. sword' philosophy in global governance transforming the dream into reality of Charlevoix Declaration of G7 Summit in 2018. The G7 leaders after declaration funded 12 years of free, safe, quality education as a hard security asset. On national ground after Malala's shooting a global petition #IAmMalala of over 3 million signatures were acted as immense force to track and ratify the Article 25-A Right to Free and Compulsory Education Bill. Malala acted as practical policy laboratory to educate girl's secondary education through Malala Fund for Right to Education in Pakistan. Malala Fund has invested $15 million in direct grants and programs since its inception in 2013 in Pakistan till 2026.

As a cross-cultural communication Malala Fund has invested over $60 million to international programs since 2013. In Afghanistan since 2021 Taliban takeover, Malala Fund treated Afghanistan as 'Gender Apartheid Front' and invested $8- $10 million to defend girl's rights. The Malala Fund has heavily expanded in Africa: Nigeria ($7M-$9M), Ethiopia ($4-$5M), Tanzania ($4-$5M) granting between $75000 to $100,000 USD supporting specific actions of AI programs, Safe Schools Declaration to protect education in conflict zones, legal reforms of gender-based violence, and Women's Response Rooms for survivors of sexual violence. In Brazil Malala Fund has invested $5M-$7M focusing on gender equity programs. The Fund invested $7M-$9M in India with focus on marginalization of women and 'Debt Justice'. In 2024-2025 Malala Fund released a policy 'Towards Debt Justice for Girls' that became central point of G20 framework of gender equality. In 2026 Summits of G20 Malala organized a coalition of 70 feminist and economic organizations (Plan International, UN Women, Nala Feminist Collective) calling for complete reform of global debt system. The slogan is: Debt is stealing girl's futures. She played the role of Global Policy Architect as a 'Third Power' watchdog ensures Youth 20 (Y20) and Women 20 (W20) groups are aligned on Debt Justice to release or unlock $506 Billion for education through debt forgiveness and restructuring.

She proved that her pen is more powerful than sword of extremists and she became the strongest force of diplomacy doesn't just speak for Pakistan but for 'all girls' and boys' creating a transnational identity of resistance. She communicates that desire of education is not only western value but a fundamental human and Islamic urge and code of conduct. According to Galtung peace education (conscientization) is different than Indoctrination (prevents peace). The conscientization is the product of conscious resistance of social, political and economic barriers of peace therefore, for Malala pen is an ultimate peacebuilding tool of divergent thinking of global policy maker. Educating girls means to dismantle structural violence of psychological warfare which keeps them discouraged and impoverished, "Girls who go to school are like buffaloes and they will go to hell" (2013). Malala getting her moral and political awakening empowers youth voice to challenge cultural violence, "Extremist have shown what frightens them most: a girl with

a book" (2013). Malala's fund is cross-cultural organization and practical implementation of global policy to make positive peace possible through education across world.

Implications

The findings and implications of research reveal that the document I Am Malala is far more than a memoir acts as transcultural bridge among nations that connects the global history, and practicality to universal appeal of youth activism around world to the struggle to seek education as a fundamental right

Conclusion

Malala's discourse is cross-cultural communication because she uses digital pen to bridge the gap between Global South and Global North creating a language of shared non-violent resistance what Galtung calls it, "peace by peaceful means". Her 'Digital Pen' served as a tool of cultural counter-violence to global voice for positive peace shifting the international policies of military intervention to structural empowerment of education. She reminds the youth of 2026 that peace is an active process of building justice and equality towards restoration of human rights for all without discrimination.

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செயற்கை நுண்ணறிவுக் காலத்தில் வகுப்பறைக் கல்வி சார் மதிப்புகள்

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Abstract

மனிதனைச் சமூகத்தில் மதிப்பு மிக்கவனாக அடையாளப்படுத்துவது கல்வியே! குருகுலக் கல்வி தொடங்கி கூகுள் கல்வி வரையிலான வளர்ச்சியானது மனித அறிவு வளர்ச்சிக்கும் அறிவியல் புரட்சிக்குமான வளர்நிலையாகும். தலைமுறை தலையெழுத்தையே மாற்றும் சக்தி கல்விக்கு உண்டு. பன்னோக்கு நிலையிலும் நுண்ணோக்கு நிலையிலும் கல்வி கற்றல் நிலையில் புரட்சி மாற்றங்கள் வந்தாலும் அறிவியலும் தகவல் தொழில்நுட்பமும் பலுகிப் பெருகினாலும் வகுப்பறைகளே கல்விக்கான மதிப்பு நிலைகளைக் கற்றுக் கொடுக்கின்றன. ஆசிரியர் – மாணாக்கர் உறவுநிலையில் ஆசிரியரானவர் மாணக்கருக்குக் கல்வி, ஒழுக்கம், சமூக மதிப்புகள், மனித மதிப்புகள் எனப் பல செய்திகளை எடுத்துரைக்கும் கருவியாக விளங்குகின்றார். செயற்கை நுண்ணறிவுக் கருவிகள் மாணாக்கருக்குக் காலத்திற்கேற்ற நுண்திறனை வளர்க்கின்றன. செயற்கை நுண்ணறிவு ஊடகம் மற்றும் தொழில்நுட்பம், மருத்துவம், உடல்நலம், ஆன்மிகம் எனப் பல்வேறு மதிப்பு அடிப்படையிலான கல்விநிலை வளர்ச்சி மனிதனை அறிவுசார் நிலையில் வளர்த்தெடுப்பினும் மாணாக்கர் உளவியல் சார் நிலையிலும் பன்நோக்கு நிலையிலும் பக்குவம் பெற வகுப்பறைகளே வித்தாக அமைகின்றன. செயற்கை நுண்ணறிவுக் காலத்தில் வாழும் இக்காலக் கட்டத்தில் வகுப்பறைக் கல்வியே, கல்வியினால் கிட்டும் விலைமதிப்பில்லா மதிப்புகளை விளக்குகின்றது என்பது ஆய்வுக் கட்டுரையின் கருதுகோளாகவும் மையமாகவும் அமைகின்றது. இதற்காக மாணாக்கரிடமிருந்து கூகுள் கருத்துப்படிவம் அனுப்பி, தகவல் பெறப்பட்ட நிலையிலும் வகுப்பறைக் கல்வியே மாணாக்கரிடமிருந்து வரவேற்கத்தக்கதாய் அமைந்ததன் வழி, செயற்கை நுண்ணறிவுக் காலத்தில் வகுப்பறைக் கல்வி சார் மதிப்புகளே மாணவ சமுதாயம் விரும்பும் கல்விமுறை என்னும் முடிபு பெறப்படுகின்றது.

திறவுச் சொற்கள்: கல்வி, வகுப்பறை, ஆசிரியர், மாணாக்கர், செயற்கை நுண்ணறிவு, இயங்கலை வகுப்பு

முன்னுரை

மனிதனுக்கான உணர்வு, உணர்ச்சி இரண்டும் உடலோடும் உள்ளத்தோடும் தொடர்புடையவை. அழுகை என்னும் உணர்ச்சி வழி, தாயின் கருவறையிலிருந்து வெளிவரும் மனிதன், அறிவு நிலையில் உணர்வுப் பூர்வமாகச் சிந்திக்கத் தொடங்குகின்றான். அறிவு சார் சிந்தனைக்கு அடித்தளம் இடுகின்றது கல்வி. ஒவ்வொரு மனிதனுக்குமான முதல் வகுப்பறை தாயின் கருவறையே! முதல் ஆசிரியர் தாயே! தாயானவள் கருவில் தன் குழந்தை இருக்கும் போதே தன்னுடைய குழந்தைக்குக் கற்றுத் தர ஆரம்பித்து விடுகின்றாள். தாயின் கருவிலேயே நுண்ணோக்கு நிலையிலான பன்னோக்குப் பார்வை சார் அனுபவக் கல்வி அரங்கேற்றம் பெறுகின்றது. தாயின் கருவறையிலேயே குழந்தைக்குத் தாய் சந்திக்கும் சூழல்கள், சிசு வளர் நிலையில் கேட்டல் திறன், உள்வாங்கும் உரைகள், உற்றுநோக்கலுக்கான அசைவுகள் எனக் கற்றல் நிலை தொடங்க ஆரம்பித்து விடுகின்றது. இது வாழ்க்கை அனுபவக் கல்விக்கான அடித்தளமாய் அமைந்து விடுகின்றது. முறையான ஏட்டுக் கல்வியறிவுக்கான பள்ளிக் கல்வியானது, அறிவு சார் முதிர்ச்சி என்னும் நிலையில் வாழ்விற்கான பயிற்சிகள் ஆக மாறுகின்றன. தொடக்க நிலையிலான குரு குலக் கல்வி முறை தொடங்கி, இன்றைய கூகுள் கல்வி வரையிலான வளர்ச்சி கட்டாயமாக மனிதனின் அறிவு வளர்ச்சிக்கும் அறிவியல் புரட்சிக்குமான வளர்நிலை என்பதில் கடுகளவும் ஐயமில்லை.

ஆயினும் வகுப்பறைக் கல்வி மட்டுமே தனிமனித ஆளுமை வளர்ச்சி, மனுக்குல மாட்சி, மனிதநேய மீட்சி மற்றும் வளர்ச்சிக்கு வித்திடுகின்றது என்பதே ஆய்வுக் கட்டுரையின் கருதுகோளாகவும் கருப்பொருளாகவும் அமைகின்றது.

கல்வியின் அவசியம்

‘நம்பிக்கை’ என்னும் சொல்லைப் பிரித்துப் பொருள் பார்த்தால், ‘நம்பி கை வை’ எனக் கொள்ளலாம். எதை நம்பி, யாரை நம்பி என்ற வினாக்களுக்கான விடையாக, தன்னை மட்டுமே நம்பி என்று பொருள் கொள்ள வைக்கும் விடையாக ஆயுதமாகக் கல்வி அமைகின்றது.

எட்டுத்தொகை நூல்களுள் ஒன்றான புறநானூற்றில் ஆரியப்படை கடந்த நெடுஞ்செழியன் கல்வியின் அவசியம் குறித்து வலியுறுத்துகின்றார்.

“உற்றுழி உதவியும் உறுபொருள் கொடுத்தும்
பிற்றைநிலை முனியாது கற்றல் நன்றே”

(புறநானூறு பா.எண் - 183)

என்கின்றார். இதே பாடலில் இன்னொரு கருத்தையும் பதிவிடுகின்றார். ஒவ்வொரு மனிதனுக்குள்ளும் தான் கண்ணால்

காணும் தெய்வம் தன் தாய் தான் என்ற நம்பிக்கை உண்டு. தாய் எத்தனைப் பிள்ளைகளைப் பெற்றெடுத்தாலும் தன் எல்லாக் குழந்தைகளிடம் மாறா அன்புடையவளாகவே இருப்பாள். அப்படிப்பட்டத் தாயின் மனம் கூடத் திரியுமாம் எப்போது என்றால்,

“பிறப்பு ஓர் அன்ன உடன் வயிற்றுள்ளும்
சிறப்பின் பாலால் தாயும் மனம் திரியும்
ஒரு குடிப் பிறந்த பல்லோருள்ளும்
‘மூத்தோன் வருக’ என்னாது அவருள்
அறிவுடையோன் ஆறு அரசும் செல்லும்
வேற்றுமை தெரிந்த நாற்பாலுள்ளும்
கீழ்ப்பால் ஒருவன் கற்பின்
மேற்பால் ஒருவனும் அவன்கண் படுமே”

(புறநானூறு பா.எண் - 183)

என்கின்றது பாடல். பாடல் கூறும் பொருள் யாதெனின், தனக்குக் கற்றுக் கொடுக்கும் ஆசிரியருக்குத் தேவையான பொருட்களைக் கொடுத்தும் உதவிகள் செய்தும் கல்வியறிவைப் பெற்றுக் கொள்ள வேண்டும். ஒரு தாய் வயிற்றில் பிறந்த பல பிள்ளைகளுள் நன்கு அறிவு படைத்தவனிடமே தாய் கூடுதலாகக் கரிசனை காட்டுவாள். பொதுவாக முதலாவதாகப் பிறந்த குழந்தை, “மூத்தபிள்ளை” **“தலைச்சன் பிள்ளை”** என்று உயரிய இடத்தில் வைத்து எண்ணப்படும். எல்லாத் தாய்மார்களும் தனக்குப் பிறந்த தலைச்சன் குழந்தை மீது அதீத அன்பு வைத்திருப்பர். இது உலக இயல்பு. ஆனால் ஒருவேளை மூத்த பிள்ளையைக் காட்டிலும் அவருக்குப் பின் பிறந்த குழந்தை அறிவுடையவராய், கல்வியறிவு பெற்றவராய்த் திகழ்ந்திடின் தாயின் அன்பு கூடத் திரியும் என்று பாடல் கருத்து விளக்குகின்றது. நாடாளும் அரசனும் அறிவுடையவரையே விரும்புவான் எனக் குறிப்பிடுகின்றது.

உலகப் பொதுமறையாம் திருக்குறளில் கல்வியின் மேன்மை, கல்வி கற்றாரின் உயர்மை, குறித்த செய்திகள் இடம் பெறுகின்றன. கல்வி என்னும் அதிகாரத்தின் கீழ் அமையும் குறட்பாக்கள் கல்வியின் மேன்மையை, கற்றாரின் சிறப்பைப் பறைசாற்றுகின்றன.

“கண்ணுடைய ரென்பர் கற்றோர்” (திருக்குறள் எண் 393) என்றும்
“ஒருமைக்கண் தான் கற்ற கல்வி ஒருவற்கு
எழுமையும் ஏமாப்பு உடைத்து” (திருக்குறள் எண் 398) என்றும்
“கேடில் விழுச்செல்வம் கல்வி” (திருக்குறள் எண் 400) என்றும் எடுத்துரைக்கின்றன.

கல்வி என்பது தலைமுறையின் தலையெழுத்தையே மாற்றக் கூடிய கூரிய ஆயுதம் ஆகும். எனவே கல்வி கற்றலில் நோக்கம்/குறிக்கோள் என்பது அவசியமாகின்றது. இலக்கு நோக்கிய கல்வி, இமயத்தின் உச்சியைக் கூடத் தொட வைக்கும். எனவே தான் வெற்றி வேற்கை,

“கற்கை நன்றே கற்கை நன்றே பிச்சை

புகினும் கற்கை நன்றே” (பாடல் எண் 35)

என்கின்றது. தலைமுறை தலைமுறையாக வறுமையில் வாடும் குடும்பம், முதல் தலைமுறைக் கல்வி என்னும் நோக்கில் வளர்ச்சி பெறுமாயின், அவர் தம் தலைமுறையானது அடுத்தடுத்த தலைமுறைக்குத் “திருப்புமுனைத்” தலைமுறை மாற்றமாய் அமையும். ஒருவர் எவ்வளவு தான் பெயரும் புகழும் மிக்கவராக இருந்தாலும் அவருக்கான அடையாளத்தை, அவர் கற்ற கல்வியால் பெற்ற பட்டப்படிப்பிற்கான அடையாளமே காட்டும். பெயருக்கு முன்னால் தந்தை அல்லது தாயின் பெயர் முன்னெழுத்தாய் அமைதல் போல் பெயருக்கு மேலும் அழகு சேர்ப்பதாய் பட்டப்படிப்பின் முன்னெழுத்தும் நெற்றிப்பொட்டு போல் அழகு சேர்க்கும். கல்வியால் பெற்ற பட்டத்திற்கான அடையாளம் சிலருக்குப் பின்னொட்டாய் அமையும். ஒருவர் மரணம் அடைந்த பின்னும் கூட, அவர் பெற்ற கல்வி அடையாளம் அவர் தம் நினைவிடக் கற்பெயரில் பொறிக்கப்படும். எனவே பன்நோக்கு மற்றும் நுண்ணோக்கு நிலையிலும் எந்நோக்கு நிலையிலும் கல்வி மனிதனுக்கு அவசியம் ஆகும்.

முன் (முதல்) நோக்கு

“எண்ணிய முடிதல் வேண்டும்
நல்லவே எண்ணல் வேண்டும்”

(பாரதியார் கவிதைகள், ப.எண்114)

என்னும் பாரதியின் பாடல் வரிகள் நல்ல எண்ணங்கள் குறித்த சிந்தனையைச் சிந்தைக்குள் இருத்தக் கற்றுக் கொடுக்கின்றன. ஒரு மனிதனிடம் ஆளுமைத் திறன் இருப்பினும் அவனைப் பேராளுமை படைத்தவனாக உருவாக்குவது அவனுடைய செயல் வெளிப்பாடுகளே! இயல்பாக மனிதன் நற்சிந்தனை படைத்தவனாக இருப்பினும், கல்வி என்னும் கருவி அவனுக்குள் இருக்கும் சிந்தனையைச் செயலாக்கியாகச் செயல்பட வைத்துச் செயல் ஆக்கம் பெறுகின்ற மனிதனாக மாற்றுகின்றது.

சிந்தனைக் களமாக வகுப்பறையும் சிந்திக்க வைக்கும் ‘கோ’வாக ஆசிரியரும் அமைகின்றனர். தன்னோடு ஒத்திசைவு இல்லாத அல்லது தன் கருத்துக்கு முரண்படுகின்ற மாற்றான்களாக தன்னுடன் பயிலும் சக மாணவரோ, மாணவர் குழாமோ அமையும் நிலையில் மாணாக்கருக்கு வகுப்பறையானது மாற்று உருவாக்கச் சிந்தனைக் களமாக மாறி விடுகின்றது.

விளை நிலத்தில் மண் உரம் பெறும் பொருட்டாய் மாற்றுப் பயிர்கள் பயிரிடுதல் போல மாணாக்கர் தம் அறிவு சார் சிந்தனை வளர்ச்சிக்கு வகுப்பறை அனுபவங்கள் விதைகளாக அமைகின்றன.

‘கண்’ - நோக்கு

“கண்ணோடு கண்ணினை நோக்கொக்கின்

வாய்ச்சொற்கள்

என்ன பயனும் இல” (திருக்குறள் எண் 1100)
என்பது செந்நாப்போதாரின் கருத்து. இத்திருக்குறளானது திருக்குறளில் காமத்துப்பாலில் தலைவன் தலைவிக்கு இடையே உள்ள உறவுநிலைக்கான குறள். ஆனால் உளவியல் நோக்கில் உற்றுநோக்கிடின் அனைத்து உறவுகளுக்குமான பாலமாய்க் கண் அமைவதைக் காணலாம். வகுப்பறையில் ஆசிரியர் கற்பித்தல் நிலையைத் தாண்டி, மாணாக்கரை, அவர் தம் பாடம் கேட்கும் அறிதிறன் நிலையைக் கண்காணிக்கின்றார். அப்போது அங்கு ஆசிரியரின் கண்கள் மாணாக்கரை அவர் தம் செயல்பாடுகளை உற்றுநோக்குகின்றன. இந்த நோக்கு மாணவரின் மனஉணர்வு வெளிப்பாட்டைக் கண்டுணர உதவுகின்றது.
வெவ்வேறு குடும்பச் சூழலில் இருந்து ஒன்று கூடும் வகுப்பறையில் மாணாக்கரது சிக்கலை, உணர்வை அறியும் தாயாக, தந்தையாக ஆசிரியர் மாறி விடுகின்றார். கருத்தரங்கப் பொருண்மை சார் நிலையில் இன்றைய மாணாக்கர் மனநிலையை ஆய்விற்கு உட்படுத்திடின் பன்நோக்கு அறிவு நிலையிலும் நுண்ணோக்கு வளர் நிலையிலும் மாணாக்கரின் வளர்ச்சி உயர்ச்சியாய்த் தான் இருக்கின்றது. ஆனால் உள நிலையிலும் உணர்வு நிலையிலும் வளர்ந்திருக்க வாய்ப்பு இல்லை என்பதே உண்மை.

ஆசிரியருக்கும் மாணாக்கருக்கும் இடையிலான அளவளாவலுக்கு வகுப்பறையே வித்திடுகின்றது. இன்றைய அறிவியல் தொழில் நுட்பத் தகவல் வளர்ச்சிப் பெருக்கு, கல்வி தாண்டிய நிலையில் மாணாக்கரைத் தன் வயப்படுத்தி விடுகின்றது. கல்வித் தேடலுக்கு உதவியாய் இருக்கும் கை பேசியோ மடிக்கணிணியோ மாணவரின் வளர்ச்சியைச் சிதைக்கும் காரணியாகி விடுகின்றது. குடி மற்றும் போதைப் பொருட்களுக்கு அடிமையானவர்களைக் கூட நன்னிலைக்குக் கொண்டு வரல் எளிது; ஆனால் அலைபேசிக்கு அடிமையானவர்களை மீட்டெடுத்தல் கடினம் எனும் நிலையிலேயே குடும்ப அமைப்பும் ஆகிவிட்டது. தாயும் தந்தையும் வேலைக்குச் செல்லும் சூழலில் தன் ஓய்வுக்காகவோ அல்லது தன் மன இறுக்கச் சூழலில் இருந்து விடுபடவோ அவர்களின் பொழுதுபோக்காகவும் கைபேசி அமைந்து விடுகின்றது. தம் பிள்ளைகளிடம் மனம் விட்டுப் பேசவோ குடும்ப அன்புறவைக் கட்டி எழுப்பவோ நேரமில்லாது போய் விடுகின்றது. விளைவு பள்ளியில் பயிலும் பருவத்தினராயினும் வளரிளம் பருவத்தினராயினும் போதுமான அன்பு, அரவணைப்பு, தன் உள உணர்வுப் பகிர்தல், தன் அளவளாவுதல் என இவற்றுக்கான வாய்ப்புக் கிட்டாச் சூழலில் பாதிப்பிற்குள்ளாகின்றனர். ஈண்டு ஆசிரியரின் ‘கண்’ நோக்கு மாணவனுக்கான கரிசனையாக மாறி விடுகின்றது. இந்த வாய்ப்பினை இயங்கலை வகுப்புத் தராது.
மனித மனக் கட்டமைப்பு, உணர்வு நிலைக் கட்டுக்கோப்பு, நெறி சார் எண்ண வளர்ப்பு, புரிதலுடனான மனமுதிர்ச்சி, உறவுநிலை

பேணுதல், சமூக உற்று நோக்கு, தன்நிலை மேம்பாடு எனப் பன்நோக்கு வளர்ச்சி நிலைக்கு வகுப்பறைக் கல்வியே வித்திடுகின்றது.

வளர்நிலை நுண்நோக்கு

வகுப்பறை என்பது பள்ளி மற்றும் கல்லூரி எனும் இருநிலைக்கும் பொதுவாகும். தொலைதூரக் கல்வியோ, அஞ்சல்வழிக் கல்வியோ இயங்கலை நிலையிலான கல்வியோ பன்னோக்கையும் நுண்ணோக்கையும் தரலாம். அது அறிவு சார் நிலைக்கும் பொருளாதார மேம்பாட்டிற்கும் மட்டும் உதவும். ஆனால் வாழ்வின் வாழ்விற்கு மகிழ்ச்சி தராது. குறுகிய வட்டத்திற்குள்ளேயே அவர் தம் வாழ்வு அமையும். அப்படியான வாழ்க்கை என்பது பயனற்றது என்பதைப் பாவேந்தர் பாரதிதாசன்,

“தன்பெண்டு தன்பிள்ளை சோறு வீடு
சம்பாத்யம் இவையுண்டு தானுண் டென்போன்
சின்னதொரு கடுகுபோல் உள்ளங் கொண்டோன்
தெருவார்க்கும் பயனற்ற சிறிய வீணன்!”(பாரதிதாசன் கவிதைகள், ப.101)

என்று குறிப்பிடுகின்றார்.

நுண்ணோக்கு நிலையில் கல்வி மாற்றம் தகவல் தொழில் நுட்ப நுண்ணறிவுத் திறனை வளர்த்தெடுத்தலில் பெரும் பங்காற்றியுள்ளது. ஆயினும் ஒரு மனிதன் தான் இன்னொருவர் மீது கொள்ளும் அதீத அன்பால், தான் மனச்சிக்கலுக்கு ஆளாவதுடன் தான் நேசிக்கும் மனிதருக்கும் துன்பத்தைக் கொடுக்கின்றாரோ அதே போல் தான் நுண்ணோக்குத் திறனுமாம். எவ்வாறெனின் நுண்ணோக்கு நிலையில் கல்வி மாற்றம் தகவல் தொழில் நுட்ப நுண்ணறிவுத் திறனை வளர்த்தெடுத்தலில் பெரும் பங்காற்றி வருகின்றது. உலகளாவிய நிலையில் கொரோனா பெருந்தொற்றுக் காலக் கட்டம் டிஜிட்டல் கல்வி நிலையில் பரிணாம உச்சத்தை வளர்த்தெடுக்க உதவியது.

அச்சூழலில் தொடங்கப்பட்ட இயங்கலை வகுப்புகள் நுண்ணறிவு நிலையில் மாணாக்கரை வார்த்துள்ளது. ஆனால் அறிவு சார் தேடல் நிலையிலோ மனிதநேய மதிப்பீட்டு நிலையிலோ பண்பாட்டு மரபு சார் ஒழுக்க வளர் நிலையிலோ ஒரு விதமான எதிர்மறை விளைவை ஏற்படுத்தியுள்ளது என்பதே உண்மை.

இயங்கலை வகுப்புக் கால கட்டங்களில் மாணாக்கர் பாடத்தைப் படிக்காமல் தேர்வு எழுதி புத்தகத்தில் உள்ள கருத்தை அப்படியே கோப்பு வடிவில் தேர்வுத்தாளைப் பதிவு செய்தமை குறிப்பிடத்தக்கது.

செயற்கை நுண்ணறிவுப் பயன்பாட்டில் தங்களின் கைவினைத்திறன் சார் வெளிப்பாடுகளையோ தனக்கான படைப்பு வெளிப்பாட்டு நுணுக்கங்களையோ வெளிக் கொணர வாய்ப்புக் கிட்டுவதில்லை.

நூலகப் பயன்பாட்டில் தான் தேடும் செய்தி தொடர்பாக உள்ள நூல்களுடன் பிற நூல்கள் கண்ணில் படும் போது வாசிப்பிற்கு வழி வகுக்கும். ஆனால் செயற்கை நுண்ணறிவுத் திறன் சார் வடிவமைப்பில் ஏற்கனவே உள்ள தரவுகளுக்குப் புற அழகு மெருகூட்டலுக்கும் கண்கவர் கவன ஈர்ப்புக்கு மட்டுமே அதிகம் வாய்ப்புள்ளது.

செயற்கை நுண்ணறிவுக் கருவிகள் மாணாக்கர் தேடும் செய்தியை மிக எளிமையாகத் தொழில் நுட்பக் கட்டமைப்பில் டிஜிட்டல் உதவியாளராகப் பன்நோக்கு நிலையில் பயன்பெறும் வகையில் தேடும் தரவுகளைத் தருகின்றன. இக் கருத்தை உறுதிப்படுத்தும் விதமாக மாணாக்கரிடமிருந்து கூகுள் கருத்துப்படிவம் அனுப்பி, தகவல் பெறப்பட்ட நிலையில்,"அறிவுப் பெருக்கத்திற்கு செயற்கை நுண்ணறிவு வழி வகுக்கின்றது" என 90.1 மாணாக்கர் பதில் பதிவிட்டுள்ளனர். ஆனால் மனித உறவு - இயந்திர நிலை என்னும் நிலையில் மதிப்பீட்டுக் கல்வி சார் ஒழுக்கங்களுக்குத் தடைசார் கருவியாகவே உள்ளன. தகவல் தொழில் நுட்ப வளர்ச்சி நிலையிலான இயங்கலை வகுப்புகள் மாணாக்கருக்கு மதிப்பீட்டுக் கல்வியைக் கற்றுத் தருவதில்லை. இக் கருத்தை ஒட்டி கேட்கப்பட்ட கூகுள் வினாத் தரவு சேகரிப்பிலும், "இயங்கலை வகுப்புகள் மதிப்பீட்டுக் கல்விக்குத் துணைபுரிவதில்லை என்று 84.5 பதில் பெறப்பட்டது.

தகவல் தொழில் நுட்ப வளர்ச்சியின் உயர்ந்த நிலையிலான இன்றைய நோக்கில் ஐயங்களுக்கான விடைகளைத் தேடி அவற்றுக்கான பதில்களை செயற்கை நுண்ணறிவு தருகின்றது. ஆனால் பெற்றுக் கொண்ட தரவுகளின் இறுதியில் அது வைக்கும் கருத்து "AI பதில்களில் தவறுகள் இருக்கலாம்" என்பது தான். எனவே, "மெய்ப்பொருள் காண்பது அறிவு" என்பதை மனதில் கொண்டு சிந்தித்துச் செயலாற்ற வேண்டும்,

முதிர்நோக்கு

கல்வி மனிதனுக்கு நம்பிக்கையைக் கொடுக்கின்றது. தான் பெற்ற கல்வி வழியாகப் பொருட்செல்வத்தால் தன் நிலை உயரும் நிலையில், பிறருடன் பொருட்செல்வத்தைப் பகிர்ந்து கொள்ள வேண்டும் என்ற மனப்பான்மையை வளர்த்துக் கொள்ள, கல்வியறிவு துணையாய் அமைதல் வேண்டும்.

தன்னை நம்பி உதவி நாடி வருவோர்க்கும் பிறர் குறிப்பறிந்து உதவுவதற்கும் தான் பெற்ற பெருவளமான அருட்செல்வம், பொருட்செல்வம் எனும் இவற்றைப் பெறாரும் பெறும் பொருட்டு உதவும் மனப்பான்மையை வளர்க்க, கல்வியறிவு உதவிடல் வேண்டும்.

நல்லெண்ணங்களையும் பரந்த மனப்பான்மையையும் சமூக அக்கறையையும் பேணுதலில் அக்கறை செலுத்துவதற்குக் கல்வியறிவு கற்றுத்தரல் வேண்டும். பாலுடன் நீர் கலந்திடினும் தன்

நிறம் மாறாப் பால் போல் கல்வி மனிதனையும் மனதையும் பக்குவப்படுத்திட வேண்டும்.

முடிவுரை

இது காறும் கல்வியை மையப்படுத்தி ஆய்வு மேற்கொண்ட நிலையில்,

- தலைமுறைத் தடைகளையும் தலையெழுத்தையும் மாற்றும் ஆயுதம் கல்வி
- கல்வி ஆளுமைக்கு அடித்தளம் இடுகின்றது.
- மனித அறிவு வளர் நிலையில் நுண்ணோக்கு நிலை வளர்ச்சிக்கு செயற்கை நுண்ணறிவு வழி வகுக்கின்றது.
- பன்னோக்கு நிலை அறிவு வளர்ச்சிக்கு வகுப்பறைக் கல்வியே வழி வகுக்கின்றது.
- பன்னோக்கு நிலையிலும் நுண்ணோக்கு நிலையில் நோக்கினாலும் வகுப்பறையே சமூகக் கட்டமைப்பைக் கட்டி எழுப்புகின்றது.

என்னும் கருத்துக்கள் பெறப்படலாகின்றன.

துணைநின்ற நூல்கள்

விகரு.இராமநாதன்(ப.ஆ), பாரதியார் கவிதைகள்,ஸ்ரீ இந்து பப்ளிக்கேஷன்ஸ், தெற்கு உஸ்மான் ரோடு, சென்னை – 35.

கோமுகி சுப்ரமணியன் (தொ.ஆ),பாரதிதாசன் தேன்தமிழ்க் கவிதைகள், நர்மதா பதிப்பகம், சென்னை – 17.

ஞா. மாணிக்கவாசகன்(உ.ஆ), புறநானூறு மூலமும் உரையும், உமா பதிப்பகம், பவளக்காரத்தெரு, சென்னை – 01.

துரை – தண்டபாணி (உ.ஆ), நீதி நூல்கள், உமா பதிப்பகம், பவளக்காரத்தெரு, சென்னை – 01.

பரிமேலழகர் (உ.ஆ), திருக்குறள், பூம்புகார் பதிப்பகம், பிராட்வே, சென்னை08

தமிழ் மருத்துவக் கல்வி

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ஆய்வுச் சுருக்கம்

அனைத்துத் துறைகளிலும் சிறந்து செயலாற்றுகின்ற நம் தமிழ்மொழி பண்டைய காலம் தொட்டே சித்த மருத்துவத்தில் சிறப்பு பெற்றுத் திகழ்கின்றது. சித்தர்களின் அறிவுக் களஞ்சியங்கள் நோயற்ற வாழ்வுக்கு வழிகாட்டும் அருமருந்தாகத் திகழ்கின்றன. உடல், உள நலன் நமது கண்கள் போன்று பாதுகாக்கப்பட வேண்டியவை. சூரிய ஒளி, சுத்தமான காற்று, ஆரோக்கியமான உணவு, உடற்பயிற்சி, நிம்மதியான உறக்கம் போன்றவை நலமிக்க மனித வாழ்வுக்கு அடிப்படை. ஆனால் அது குறித்த விழிப்புணர்வு குழந்தைப் பருவத்திலிருந்து நமக்குப் பாடமாகப் புகட்டப்பட வேண்டும். அடிப்படையான நம் பாரம்பரிய மருத்துவக் குறிப்புகளை மாணவர்களுக்குக் கற்றுக்கொடுக்கும் போது சிறிய நோய்களுக்கும் மருத்துவரை நாடிச் செல்ல வேண்டிய தேவை இருக்காது. நாடி நடை, தமிழர் மருத்துவம், மருத்துவம் குறித்த இலக்கியப் பதிவுகள், தானியங்களும் உடல் நலனும், சமையற்கூட மருந்தகம், உணவே மருந்தாதல், மருத்துவ இதழ்கள், தமிழ் மருத்துவக் கல்வியின் தேவை, பாடத்திட்ட நோக்கில் தமிழ் மருத்துவம் போன்றவற்றின் மூலம் தமிழ்

மருத்துவக் கல்வியின் முக்கியத்துவம் குறித்த விழிப்புணர்வை ஏற்படுத்துவதை நோக்கமாகக் கொண்டு இக்கட்டுரை அமைகிறது.

முக்கியச் சொற்கள்

தமிழ் மருத்துவக் கல்வி, சித்த மருத்துவம், அறிவுக் களஞ்சியங்கள், உடல், உள நல மருத்துவம், ஆரோக்கிய விழிப்புணர்வு, தடுப்பு மருத்துவம்.

முன்னுரை

மனிதன் ஆரோக்கியமான வாழ்வையே விரும்புகிறான். எளிமையான முறையில் கருவிகளின் துணையின்றி நோய்களைக் கண்டறிந்து இயற்கையான பொருட்களால் நோயின்றி நலமிக்க வாழ்வை அமைத்துக்கொள்ள முயற்சி மேற்கொண்டதால் உருவானதே 'நாட்டு மருத்துவம்'. பண்டைக்காலம் தொட்டே நாட்டு மருத்துவம் தமிழர் மருத்துவமாக நடைமுறையில் இருப்பதை நாம் அறிவோம். பாட்டி வைத்தியம் என்பது பக்கவிளைவுகள் அற்ற ஒரு மருத்துவ முறையாகும். சித்தர்களின் மருத்துவக் குறிப்புகள் நமக்கு மிகுந்த பலன் அளிப்பதாக அமைகின்றன. கிராமப்புறத்தில் வைத்தியர், நாட்டு மருத்துவர், மருத்துவச்சி என்ற சொல்லாட்சிகள் இன்றும் பயன்படுத்தப்பட்டு வருகின்றன. நம் தமிழ் மருத்துவ முறைகளை நம் முன்னோர் குறைந்த செலவில் நிறைந்த பலனை அளிக்கும் வகையில் பயன்படுத்தி நலமிக்க வாழ்வினை அமைத்துக் கொண்டனர்.

நவீன காலத்தில் தொலைத் தொடர்புச் சாதனங்களின் பெருக்கத்தால் வலையொளியில் ஏராளமான பாட்டி வைத்தியக் குறிப்புகள் வெளிவருவதைக் காண்கிறோம். நாம் இருந்த இடத்திலிருந்து நோய்க்கான காரணம், நோய்க்கான அறிகுறிகள், சிகிச்சை முறைகள், நோய் பரவாமல் தடுக்கும் முறைகள் போன்றவற்றைத் தெளிவாக அறிந்துகொள்ள முடிகின்றது. பழமையான நமது மருத்துவத்தை முழுமையாக மீட்டெடுத்து வருங்காலச் சந்ததியினரும் அதன் பயனைப் பெற ஆவன செய்ய வேணடியது கல்வியாளர்களின் கடமையாகும். எனவே, தமிழ் மருத்துவக் கல்வி குறித்த விழிப்புணர்வை ஏற்படுத்துவதை நோக்கமாகக் கொண்டு இக்கட்டுரை அமைகிறது.

நாடி நடை

தமிழ் மருத்துவ முறையில் முதன்மையானது நாடி நடை பார்ப்பதாகும். இதயம் சுருங்கி விரிவதால் ரத்த நாளங்கள் சுருங்கி விரிகிறது. இதனை 'நாடி நடை' என்று கூறுகிறோம். கைகள், நெற்றிப்பொட்டு, கணுக்கால் போன்ற இடங்களில் நாடி நடை பார்க்கப்படுகிறது. கையில் மணிக்கட்டுக்கு அருகில் மூன்று விரல்களை அழுத்தி நாடி பார்ப்பதே பெரும்பான்மையான மருத்துவர்களின் நாடி பார்க்கும் முறையாகும். குறிப்பிட்ட அளவில் நாடி நடை இருந்தால், உடல் ஆரோக்கியமாக இருப்பதாகக் கருதலாம். எந்த நாடி நடை அதிகமாக இருக்கிறதோ அல்லது குறைவாக இருக்கிறதோ அதன் இயல்புத் தன்மையில் மாற்றம் இருப்பதாக உணர்ந்து அதற்கு ஏதுவான உணவை உட்கொள்வதன் மூலம் அல்லது அதிகமாக இருப்பின் அந்த உணவைத் தவிர்ப்பதன் மூலம் நமது உடலை ஆரோக்கியமாக வைத்துக் கொள்ளலாம். திருமூலர்,

"எல்லையே வாதம் எழில் நடை கோழியாம்

எல்லையே பித்தம் எழுப்பும் தவளை போல்

எல்லையே ஐயம் ஊர்ந்திடும் பாம்பு போல்

அல்லையே கண்டிங்கு அறிந்தவர் சித்தரே" [1]

என்பார்.

வாதம்	பித்தம்	கபம்
ஆள்காட்டி விரல்	நடுவிரல்	மோதிர விரல்
ஒரு மாத்திரை	அரை மாத்திரை	கால் மாத்திரை
குருவி, கோழி நடப்பது போன்று இருக்கும்.	தவளை, மயில் நடையை ஒத்திருக்கும்.	பாம்பு, சிலந்தி ஊர்வது போன்றிருக்கும்.

பயிற்சியின் மூலம் இதன் நுட்பமான தன்மையை அறிந்து நாமே நமது உடலை மருத்துவரின் துணையின்றிப் பாதுகாக்க இயலும். உடல் நலமுடன் இருக்க, தினமும் குறித்த வேளையில் உண்ண வேண்டும்.

மலச்சிக்கலைத் தரும் புளிப்பு உணவுகளைத் தவிர்த்து உப்பு சுவையுடைய உணவுகளை உண்ண வேண்டும். மலம், சிறுநீர், வியர்வை போன்றவற்றைத் தினமும் வெளியேற்ற வேண்டும். ஜீரணிக்கக்கூடிய உணவுகளை எடுத்துக் கொள்வதால் நோயின்றி வாழ இயலும். உண்ணும் உணவின் கடினத் தன்மைக்கேற்ப உறங்க வேண்டும்.

தமிழர் மருத்துவம்

நமது பாரம்பரிய மருத்துவமும் சித்த மருத்துவமும் இணைக்கப்பட்டு 'சித்த மருத்துவம்' என்றே அழைக்கப்படுகின்றது. அறிவியல் அடிப்படையிலான பல்வேறு சிகிச்சை முறைகள் சித்த மருத்துவத்தில் இருப்பதை அனைவரும் அறிந்து பயன்படுத்தி நம் பாரம்பரிய மருத்துவத்தை மீட்டெடுக்க வேண்டியது நமது கடமையாகும். எனவே, பள்ளி, கல்லூரி, பல்கலைக்கழகப் பாடத்திட்டத்தில் இதனைக் கொண்டு வந்து மாணவர் சமுதாயமும் இம்மருத்துவ முறைகளைப் பின்பற்றி, அழிந்துபடாமல் காக்க ஆவன செய்ய வேண்டும். பெருந்தொற்றுக் காலத்தில் நம் பாட்டி வைத்தியம் பல்வேறு நோயாளிகளைக் காத்தது மட்டுமல்லாது, நோயணுகாமலும் காத்ததை நாம் அறிவோம்.

வெளிநாட்டவர் நம் நாட்டை ஆண்ட பொழுது அவர்களுடைய மருத்துவ முறைகள் தலை தூக்க ஆரம்பித்தது. தமிழகப் பூர்வ குடிகளின் மருத்துவ முறைகள் மதிப்பிழந்த நிலையில் இருந்தது. அனைத்து நோய்கள் குறித்தும் கற்கின்ற 'பொது மருத்துவர்' என்ற மருத்துவக் கல்வித் திட்டம் கொண்டுவரப்பட்டது. அலோபதி மருத்துவத்தில் மருந்து, மாத்திரைகள், சிகிச்சை முறைகள், நவீனக் கருவிகளுடனான சிகிச்சை, காப்பீட்டு திட்டங்கள் என்று வணிக நோக்கத்தில் மருத்துவ முறைகள் மாற்றம் பெற்றதன் காரணமாக நம் பாரம்பரிய மருத்துவ முறைகள் கொஞ்சம் கொஞ்சமாகக் குறைய ஆரம்பித்துள்ளது. இன்றைய உலகில் மருத்துவக் கல்வியைப் பொருளாதார வசதி உள்ளவர்கள் மட்டுமே பெற முடியும் என்ற நிலை ஏற்பட்டுள்ளது. ஏழைகள் அறிவாற்றலில் சிறந்து இருப்பினும் 'நீட் தேர்வு' முறை, அதற்கான பயிற்சி வகுப்புகள் போன்றவற்றால், இக்கல்வி அவர்களுக்கு எட்டாக்கனியாகி உள்ளது. நம் பாரம்பரிய சித்த மருத்துவத்தை மீட்டெடுக்கும் முயற்சியாக நமது தமிழக அரசு எட்டாம்

வகுப்புத் தமிழ்ப் பாடத்திட்டத்திலும் கல்லூரி பாடத்திட்டத்திலும் சித்த மருத்துவத்தைப் பாடமாக வைத்திருப்பது வரவேற்கத் தகுந்த ஒன்றாகும்.

மருத்துவம் குறித்த இலக்கியப் பதிவுகள்

சங்க காலத்திற்கு முன்னரே சித்து கலைகளில் தேர்ச்சி பெற்றவர்கள் வாழ்ந்திருந்தாலும் 'சித்தர்' என்ற பெயரால் அவர்கள் அழைக்கப்படவில்லை. தொல்காப்பியத்தில்,

"நிறைமொழி மாந்தர் ஆணையிற் கிளந்த

மறைமொழி தானே மந்திரம் என்ப" [2]

என்ற நூற்பாவில் 'நிறைமொழி மாந்தர்' என்ற சொல் சித்தர்களைக் குறிப்பதாகக் கூறப்படுகிறது .

சித்தர்கள் சமயங்களைக் கடந்து உயிரில் இறைமையைக் காண்பவர்கள். 'உள்ளம் பெருங்கோயில் ஊனுடம்பு ஆலயம்' என்னும் கோட்பாட்டைக் கொண்டவர்கள். எண் வகை சித்திகள் அறிந்து நோயையும் சாவையும் கடந்தவர்கள். சமய, மூடப் பழக்க வழக்கங்களுக்குக் கட்டுப்படாமல் மக்களை நல்வழிப்படுத்தி, யோக நிலையில் இறைவனை அடையும் வழிகளைக் கற்பித்தவர்கள். அகத்தியர் முதலான 18 சித்தர்கள் முக்கியமானவர்களாகக் கூறப்பட்டாலும் நூற்றுக்கும் மேற்பட்ட சித்தர்கள் வாழ்ந்துள்ளனர். சித்தர்கள் அதிகமாக வாழ்ந்து தனது பாடல்களால் சமூக மாற்றத்தைக் கொணர விழைந்த கி.பி.16, 17-ஆம் நூற்றாண்டு காலப் பகுதியைச் 'சித்தர் காலம்' என்று குறிப்பிடுவர். மனித வாழ்க்கை மகத்துவம் நிறைந்தது. ஆனால் உலக இன்பங்களில் மூழ்கி அதனைப் பாழ்படுத்தும் அவல நிலையினைக் கடுவெளி சித்தர் தனது பாடலில் பதிவு செய்கிறார்.

"நந்தவனத்தில் ஓர் ஆண்டி - அவன்

நாலாறு மாதமாய் குயவனை வேண்டிக்

கொண்டு வந்தான் ஒரு தோண்டி - மெத்தக்

கூத்தாடிக் கூத்தாடிப் போட்டுடைத் தாண்டி" [3]

மனித மனத்தைச் செம்மைப்படுத்தும் நெறிமுறைகளை மேற்கொண்டு இறையை அடையும் வழிமுறைகளைச் சமய நூல்கள் நமக்குக் கற்றுத் தருகின்றன. ஆனால், பொய்மை வாதிகள் இறைவனை மறந்து விட்டுச் சமயங்களைத் தாங்கிப் பிடித்துக் கொண்டு மக்களின் மனங்களைக் கெடுக்கின்ற அவலத்தைப் போக்குவதை நோக்கமாகக் கொண்டு சித்தர் பாடல்கள் அமைந்தன. சித்தர்கள் பெரும்பாலும் நாட்டுப் புறங்களில் வாழ்ந்தனர். அங்குள்ள மக்களுக்குப் புரியும் வகையில் மருந்து முறைகளைக் கற்பித்தனர். பாட்டி வைத்தியம், நாட்டு வைத்தியம் அனைத்தின் மூலமாக இருப்பவை பதினெண் சித்தர்களின் மருத்துவக் குறிப்புகளாகவே அமைகின்றன. காடு, மலைகளில் அலைந்து தேடிப் பல்வேறு மூலிகைகளைப் பறித்து அதன் மருத்துவக் குணங்களைப் பதிவுகளாக்கி, செய்முறை விளக்கங்களோடு பதிவிட்ட சித்தர்களின் மருத்துவப் பணி போற்றுதற்குரியது.

“அழிந்து அயல் அறிந்த எவ்வம் மேற்படப்

பெரும்பேதுறுதல் களைமதி பெரும!

வருந்திய செல்லல் தீர்த்த திறன் அறிஒருவன்

மருந்து அறை கோடலின் கொடிதே யாழநின்

அருந்தியோர் நெஞ்சம் அறிந்து உகவிடினே” [4]

மருத்துவன் நோயாளியின் நோயினைக் கண்டவுடன் மருத்துவம் செய்தால் நோயைக் குணப்படுத்துவது எளிதாகும். நோய் முற்றிய பின்னர் மருந்தளித்தால் எப்பயனும் விளைவதில்லை. மருத்துவன் தன்னிடமுள்ள மருந்தை மறைத்து வைப்பதைக் காட்டிலும் கொடியது உன்னைப் பருகிய என் நெஞ்சத்தைக் கலங்க வைப்பது என்கிறாள் சங்கத் தலைவி.

“பசும் புலி வேட்கை கடுஞ்சூல் மகளிர்

மீன்தேர் கொட்பிற் பனிக்கய மூழ்கிச்

சிரல் பெயர்ந் தென்ன நெடுவள் ஊசி

நெடுவசி பரந்த வடுவாழ் மார்பின்” [5]

இன்று நவீனக் கருவிகள் மூலம் மருத்துவர்கள் செய்யும் அறுவைச் சிகிச்சை போன்று அன்று போரில் புண்பட்ட வீரர்களுக்குப் புண்ணைத்

தைக்கும் சிகிச்சை இருந்ததனைப் பதிற்றுப்பத்து இங்ஙனம் எடுத்துரைக்கிறது.

சங்ககாலப் புலவர்கள் பலரும் மருத்துவம் குறித்து அறிந்திருந்தனர். எட்டுத்தொகை> பத்துப்பாட்டில் மருத்துவக் குறிப்புகள் அதிகம் இடம் பெறவில்லை. எனினும், மருத்துவன் தாமோதரன், நல்லச்சுதனார் பற்றிய குறிப்புகள் காணப்படுகின்றன. பதினெண் கீழ்க்கணக்கு நூல்களில் திரிகடுகம், சிறுபஞ்சமூலம், ஏலாதி ஆகிய மூன்றும் 'மருந்து நூல்கள்'என்றே அழைக்கப்படுகின்றன. திருவள்ளுவர் 'மருந்து' என்று ஒரு அதிகாரத்தையே வகுத்துத் தந்துள்ளார். நன்கு பசித்த பின்னர் உண்ண வேண்டும். முதலில் உண்ட உணவு செரிமானம் அடைந்த பின்னர் உண்ணுதல் முறையாகும். இதனை,

"மருந்தென வேண்டாவாம் யாக்கைக்கு அருந்தியது

அற்றது போற்றி உணின்" [6]

என்கிறார். அளவோடு உண்ணுதல் செரிமானத்திற்கு வழிவகுக்கும்.

"மிகினும் குறையினும் நோய் செய்யும் நூலோர்

வளி முதலா எண்ணிய மூன்று" [7]

வளி முதலா என்பது வாதம், பித்தம், கபத்தைக் குறிப்பிடுகிறது. ஒருவன் உண்ணுகின்ற உணவும் செயலும், இந்த மூன்றுக்கும் ஒவ்வாது இருந்தால் நோய் ஏற்படும் என்கிறார்.

"அஞ்சனக் குன்றேய்க்கும் யானை அமருழக்கி

இங்குலிகக் குன்றே போல் தோன்றும்" [8]

என்ற களவழி நாற்பதில் செங்கட் சோழன் போரிட்ட களத்திலுள்ள யானைகள் இங்குலிகக் குன்று போல சிவந்து தோன்றியது என்கிறார் பொய்கையார். சங்க காலத்தில் இப்பொருள் பயன்பாட்டில் இருந்தது குறிப்பிடத்தக்கது. '**இங்குலிகம்**'என்றால் '**சாதுலிங்கம்**' என்று பொருளாகும். சீனத்திலிருந்து இறக்குமதியாகின்றது. சாதுலிங்கத்தைச் சுத்தப்படுத்தி அதிலிருந்து **சாதுலிங்க செந்தூரம்** மற்றும் **பற்பம்** தயாரிக்கப்படுகிறது. இது தீராத நாள்பட்ட நோய்களைத் தீர்க்கவும் உடலைப் பலப்படுத்தவும் பயன்படுகிறது.

சிந்துவெளி நாகரிக அகழாய்வில் கிடைக்கப்பெற்ற '**மான் கொம்பு, பவளம், தாளகம்**' போன்ற பொருட்களைப் பண்டைய தமிழர்கள் பயன்படுத்தினர். இளம் வயது மானின் கொம்புகள் வெல்வெட் எனப்படும் மென்மையான தோலால் மூடப்பட்டிருக்கும்> இப்பகுதி பாரம்பரிய சீன மருத்துவத்தில் பயன்படுத்தப்படுகிறது. **பவளம்** - இது நவரத்தினங்களில் ஒன்று. கடலிலிருந்து கிடைக்கும் பொருளாகும்> சித்த மருத்துவத்தில் பவள பற்பம் தயாரிக்கப்பட்டுப் பல்வேறு நோய்களுக்கும் மருந்தாகப் பயன்படுத்தப்பட்டு வருகின்றது. நுரையீரல் தொடர்பான நோய்கள், ரத்த சோகை மற்றும் சுத்திகரிப்பு, எலும்பு, கல்லீரல், தோல் நோய்கள் போன்றவற்றுக்கும் மருந்தாகப் பயன்படுகின்றது. **தாளகம்** - பல்வேறு காய்கறிகள், பருப்பு வகைகள், மிளகாய், தேங்காய், வெல்லம் சேர்த்துத் தயாரிக்கப்படும் ஒரு உணவாகும். இது செரிமானத்திற்கும் சளித் தொல்லைக்கும் மருந்தாகப் பயன்படுகிறது. இது பாரம்பரிய ஒரு குழம்பு வகையாகும்.

சிலப்பதிகாரத்தில் மாதவி நீராடிய நீரில் பத்து வகைப்பட்ட துவர், (துவர்ப்புத்தன்மை கொண்ட நறுமணப் பொருட்கள்), ஐந்து வகைப்பட்ட விரை, (கூந்தலை நறுமணம் ஊட்ட பயன்படுத்தப்பட்ட நறுமணப் பொருட்கள்), 32 வகை ஓமாலிகை ஆகிய 47 மருந்து பொருட்கள் சேர்த்து ஊறிக் காய்ந்;தது என்று குறிப்பிடப்படுகிறது. இம்மூலிகைநீர் நோயின்றி உடல் வனப்புப் பெறுவதற்காகவும் பயன்படுத்தப்பட்டுள்ளது.

"பத்துத் துவரினும் ஐந்து விரையினும்
முப்பத் திருவகை யோமா லிகையானும்
ஊறின நன்னீர் வுரைத்த நெய்வாசம்
நாறிருங் கூந்தல் நலம்பெற ஆட்டிப்
புகையில் புலர்த்திய பூமென் கூந்தலை
வகைதொறு மான்மதக் கொழுஞ்சே றூட்டி" [9]

பிற்காலச் சோழர்காலத்தில் மக்கள் மீது அக்கரை கொண்ட மன்னர்கள் மருத்துவமனைகளை அமைப்பதிலும் மருத்துவர்களைப் பேணுவதிலும் மானியங்கள் வழங்குவதிலும் கவனம் செலுத்தி வந்துள்ளனர். இதனைச் சோழர்காலச் சாசனங்கள் தெளிவுபடுத்தியுள்ளன. **"வைத்திய பாகம்" "வைத்திய விருத்தி"**

“மருத்துவப் பேறு”[10] என்பவை மருத்துவமனைகள் எழுப்ப நிலம் வழங்கியமையைத் தெளிவுபடுத்துகின்றன.

“1968 ஆம் ஆண்டு பேரறிஞர் அண்ணா அவர்களால் நடத்தப்பெற்ற இரண்டாம் உலகத் தமிழ் மாநாட்டின் வாயிலாகச் ‘சித்த மருத்துவம் உலகப் பார்வையினைத் தன்பால் ஈர்த்தது. சித்த மருத்துவம் இதேபோல் இலங்கையிலும் மறைந்த பிரதமர் அவர்கள் எஸ். டபுள்யு. ஆர். டி. பண்டார நாயக்க சுதேச மருத்துவத்துக்கு ஒரு எழுச்சியை ஏற்படுத்தினார். இதன் பயனாக 1961 ஆம் ஆண்டு இலங்கைப் பாராளுமன்றத்தில் ஒரு கட்டுக்கோப்பான ஆயுர்வேதச் சட்டத்தினைக் கொண்டு வந்து நிறைவேற்றி ஆயுர்வேத மருத்துவத்தின் கீழ் சித்த மருத்துவம் ஒரு பிரிவாக கணித்து வளரலாயிற்று. அது இன்று உயர்கல்வி அமைச்சின் கீழ் பல்கலைக்கழக அந்தஸ்து பெற்றிருப்பது குறிப்பிடத்தக்கச் சிறப்பாகும்”[11]

மனிதர்களைத் தவிர பிற உயிரினங்கள் நோயினால் அவதியுற்றுப் பிறர் உதவியை நாடியதில்லை. மனிதரைப் போன்று நோயினால் வருந்தாமைக்குக் காரணம் அவை காய், கனி, இலைகள், தானியங்கள், இறைச்சி உணவுகளை உட்கொள்வதே ஆகும். ஆறு சுவைகளையும் நம் உணவில் சேர்க்கும் பொழுது நோய்கள் ஏற்படுவதற்கான வாய்ப்புக் குறையும்.

இரவு 7 மணிக்குள் நாம் இரவு உணவை முடித்து விட வேண்டும். 10 மணிக்குள் நாம் உண்ட உணவு ஜீரணித்து விடும். நாம் தூங்கும் பொழுது முழு சக்தியும் உடம்பில் உள்ள தேய்மானங்களைப் புதுப்பிக்க பயன்படும். உடம்பில் பசி அடிக்கடி எழுகிறது என்றால் உடலுக்குள் புழு பூச்சிகள் இருப்பதை அறிந்து கொள்ளலாம். நாம் உண்ணும் உணவை அவைகளும் உண்பதால் நமக்குப் பசி அதிகமாக எழுகிறது. வேப்பிலை, பாகற்காய், சுண்டைக்காய், வெந்தயம் போன்ற கசப்பான உணவுகளை நாம் அடிக்கடி சேர்த்துக் கொள்ளும் பொழுது பூச்சிகள் மடிந்து வெளியேறுவதால் பசி உணர்வு குறைந்து விடும்.

தானியங்களும் உடல் நலனும்

நம் முன்னோர் அடிப்படைத் தேவையான உணவினைத் தாமே உற்பத்தி செய்து அதைப் பக்குவப்படுத்தி உண்டும் ஏற்றுமதி செய்தும் தன்னிறைவோடு வாழ்ந்தனர். ஐந்து நிலப் பகுதியில் விளைந்த

தானியங்களை அந்நில மக்கள் பயன்படுத்தியதுடன் பண்டமாற்று முறையில் மற்ற நிலங்களின் விளைப் பொருட்களையும் உண்டு மகிழ்ந்தனர். தானியங்கள் மக்களின் முதன்மையான உணவாகும். நார்ச்சத்து, புரதம், வைட்டமின்கள், தாதுக்கள் நிறைந்த முக்கியமான உணவான அரிசி, கோதுமை, பார்லி, ஓட்ஸ் போன்றவை உடலுக்கு ஆற்றலை அளிக்கிறது. சிறு தானியங்கள் அளவில் சிறியதாக இருப்பதால் இப்பெயர் பெற்றது. கம்பு, வரகு, சாமை, தினை, கேழ்வரகு, குதிரைவாலி, சோளம் போன்றவை சிறுதானியங்கள் எனப்படுகிறது.

தானியங்களின் பெயர்கள்	**சத்துப் பொருட்கள்**	**மருத்துவப் பயன்கள்**
அரிசி	வைட்டமின் பி1 பி3, கார்போஹைட்ரேட், கால்சியம், நார்ச்சத்து, இரும்புச்சத்து ,புரதம்	முக்கியமான உணவு வயிறு தொடர்பான நோய்களை அகற்றி அமிலத்தன்மையைக் குறைக்கிறது
கோதுமை	கால்சியம், நார்ச்சத்து, இரும்புச்சத்து ,புரதம்	செரிமானத்தை மேம்படுத்தி இதய ஆரோக்கியத்தை அதிகரிக்கிறது
பார்லி	நார்ச்சத்து, வைட்டமின் பி	கெட்ட கொழுப்பை அகற்றும், உடல் அழற்சியைக் குணமாக்கும், உடலில் சர்க்கரையின் அளவைக் குறைக்கும்,
ஓட்ஸ்	நார்ச்சத்து, புரதம், பாஸ்பரஸ், காப்பர், ஆண்டி ஆக்சிடென்ட்	ரத்த சர்க்கரை அளவைச் சீராக்குகிறது. கெட்ட கொழுப்பைக் கரைத்து நோய் எதிர்ப்பாற்றலைத் தூண்டுகிறது
கம்பு	நார்ச்சத்து, இரும்புச்சத்து, சுண்ணாம்பு	சர்க்கரை அளவைச் சீராக்கும், உடல் சூட்டைத் தணிக்கும், இதய ஆரோக்கியத்தை மேம்படுத்தும்
வரகு	நார்ச்சத்து, வைட்டமின், கால்சியம், இரும்புச்சத்து, சுண்ணாம்பு, பாஸ்பரஸ்	உடல் எடையைக் குறைக்கும், நீரிழிவு நோயைக் கட்டுப்படுத்தும், மலச்சிக்கலைப் போக்கும்.
சாமை	மக்னீஷியம், சோடியம், பொட்டாசியம், புரதம், நார்ச்சத்து, இரும்புச்சத்து	சர்க்கரை அளவைச் சீராக்கும், எலும்புக்கு ஊட்டமளிக்கும், இதயம் தொடர்பான நோய்களிலிருந்து பாதுகாக்கும்.

தினை	பீட்டா கரோட்டின், நார்ச்சத்து, இரும்புச்சத்து, கால்சியம்	கருப்பை தொடர்பான நோய்களைப் போக்கும், உடல் சூட்டைத் தணிக்கும், இதயம், சிறுநீரக ஆரோக்கியத்தை மேம்படுத்தும்
கேழ்வரகு	சுண்ணாம்பு சத்து, இரும்பு, புரதம், தாது உப்பு	நீரிழிவு நோயைக் கட்டுப்படுத்தும், ரத்த அழுத்தம், கல்லீரல் நோய், ஆஸ்துமாவைக் குணப்படுத்தும்
குதிரைவாலி	புரதம் ,மாவுச்சத்து, சுண்ணாம்புச்சத்து இரும்புச்சத்து, பாஸ்பரஸ்	உடல் வலிமை அதிகப்படுத்தும், மன அழுத்தத்தைக் குறைக்கும்
சோளம்	நார்ச்சத்து, இரும்புச்சத்து, ஆண்டி ஆக்சிடென்ட்	உடல் எடையை அதிகரிக்கும்,. கண் பார்வையை மேம்படுத்தும்

சிறுதானியங்களையே நம் முன்னோர் அதிகமாகப் பயன்படுத்தி வந்தனர். சத்துக்கள் அதிகம் நிறைந்த சிறு தானியங்கள் குறித்த விழிப்புணர்வு மக்களிடையே எழுந்ததன் காரணமாக இன்று இல்லங்களிலும் உணவகங்களிலும் வித்தியாசமான பல்வேறு வகைகளில் உணவினைத் தயாரித்து உண்ணும் நிலை ஏற்பட்டுள்ளது. இதன் விலை ஏற்றம் சற்று அதிகமாக இருப்பதால் அனைவராலும் இதன் பயனை முழுமையாக அடைய இயலா நிலை உள்ளது. எனினும் உடல் ஆரோக்கியத்தை மேம்படுத்தும் சிறு தானியங்களின் உற்பத்தியை அதிகப்படுத்தினால் விலை உயர்வினைக் கட்டுப்படுத்தினால் அனைவரும் இதன் பயனை அடைய இயலும்.

சமையற்கூட மருந்தகம்

இயற்கை மனிதனுக்கு வழங்குகின்ற பல்வேறு பொருட்கள் அருமருந்தாக அமைகின்றன. அதிலும் குறிப்பாக நம் சமையற் கூடத்தில் நாம் பயன்படுத்துகின்ற ஒவ்வொரு உணவுப் பொருளும் முற்றிலும் மருத்துவக் குணம் நிறைந்தவையே. இதனை அறிந்தே மக்கள் காலம்காலமாக இதனைப் பயன்படுத்தி வருகின்றனர். உடல் வளர்ச்சிக்குப் பயன்படுகின்ற உணவுப் பொருள்கள் மட்டுமின்றி நோய் வராமல் பாதுகாப்பதற்கும் வந்த நோயைக் குணப்படுத்துவதற்கும் பல்வேறு மசாலாப் பொருட்களை நம் சமையல் அறையிலேயே வைத்துப் பயன்படுத்தி வருகின்றோம்.

மஞ்சள்: இதில் மூன்று வகைகள் உள்ளன. கறி மஞ்சள், பூசு மஞ்சள், கஸ்தூரி மஞ்சள். இவற்றுள் நாம் சமையலுக்குப் பயன்படுத்தும்

கறிமஞ்சள் மங்கலப் பொருளாக மட்டுமின்றி, கிருமி நாசினியாகவும் செயல்படுகிறது. பித்தம், வாந்தி, தலைவலி, சளி, வாத நோய்கள் போன்றவற்றுக்கு அருமருந்தாக அமைகிறது.

மிளகு: சளி இருமலுக்குச் சிறந்த நிவாரணியாகவும், விஷத்தினால் ஏற்படும் நச்சுத்தன்மையை அகற்றவும், ஜீரண சக்தி பெறவும் பயன்படுகிறது.

சீரகம்: ஜீரண சக்தியை அதிகப்படுத்தவும், பசியைத் தூண்டவும், மேனி அழகிற்கும், கண்பார்வையைச் சீராக்கவும> வயிற்று கோளாறுகள் நீங்கவும் இதனைப் பயன்படுத்துவர்.

வெந்தயம்: வயிற்றுப் பொருமல், மந்தம், வாயு, இருமல், வயிற்று வலி, சர்க்கரை நோயைக் கட்டுப்படுத்துதல், மலச்சிக்கலை நீக்குதல், குடல் புண்ணை அகற்றுதல் இதன் பயன்கள் ஆகும் .

சோம்பு: வயிற்று வலி, வயிற்றுப் பொருமல், கண் நோய் குணமாவதற்கும் செரிமானத்திற்கும் சளி, இருமல், ஆஸ்துமா, மாதவிடாய் வலி, உடல் எடை குறைப்பு, கொழுப்பினைக் கட்டுப்படுத்துதல், சர்க்கரை அளவினைக் கட்டுப்படுத்துதல் இதன் பயனாகும்

பூண்டு: கிருமி நாசினியாகவும், செரிமானத்தை அதிகரிக்கவும், பசியைத் தூண்டவும், உயர் ரத்த அழுத்தத்தைக் கட்டுப்படுத்தவும், இருமல், சளி, ஆஸ்துமா, வாத பிரச்சனைகள், நீரிழிவு போன்றவற்றுக்கும் மருந்தாகிறது.

கொத்துமல்லி: கண்பார்வைத் தெளிவு, பல் உறுதிப்படுதல், ஜீரண சக்தி, பித்தம், வாதம் போன்றவற்றிற்கும் நீரழிவு நோய், சளி, தேமல், மனநோய் போன்றவற்றுக்கும் மருந்தாகிறது.

ஏலக்காய்: வயிற்றுப் பொருமலை நீக்கி, செரிமானத்தைத் தூண்டுதல், வாந்தியைக் கட்டுப்படுத்துதல், சிறுநீர் தொடர்பான நோய்களை நீக்குதல், வாய் துர்நாற்றத்தைக் குறைத்தல், சளி இருமலைக் குணப்படுத்துதல், மன அழுத்தத்தைக் குறைத்தல்

இலவங்கப்பட்டை: வயிறு தொடர்பான நோய்களுக்கு மருந்தாகிறது. மூளையின் இயங்காற்றலுக்கும், சீரான ரத்த ஓட்டத்திற்கும், நீரிழிவு நோய்க்கும் மருந்தாகிறது. உடலில் உள்ள நச்சுக்களை அகற்றி, செரிமானத்தைத் தூண்டுகிறது. சளிக்கும் சிறந்த மருந்தாகிறது.

கிராம்பு: வாய் துர்நாற்றத்தைப் போக்கிப் பல் வலியினைக் குணப்படுத்துகிறது. நோய் எதிர்ப்பாற்றலை அதிகப்படுத்தி, வயிறு தொடர்பான நோய்களுக்கும், இருமல், சளி போன்றவற்றிற்கும் மருந்தாகிறது.

நம் சமையல் அறையில் பயன்படுத்தும் முக்கியமான மசாலா பொருட்கள், பொதுவாக அனைவருக்கும் அடிக்கடி ஏற்படுகின்ற நோய்களுக்குச் சிறந்த மருந்தாக அமைகின்றது. மருத்துவரை அணுகாமல் கைமருந்தாக நாம் இவற்றைப் பயன்படுத்தி உடல் ஆரோக்கியத்தை அடைய முடிகிறது.

உணவே மருந்தாதல்

ஒவ்வொரு மனிதருக்குள்ளும் ஒரு மருத்துவர் செயல்படுகிறார். நமது உடலாகிய மருத்துவர் உடலுக்கு எது நன்மையானது, எது தீங்கானது என்பதை அறிந்து செயல்படுகிறார். உடல் சூடு அதிகரிக்கும் பொழுது வியர்வை மூலம் தணித்துக் கொள்ளுதல், தூசு, நுண்கிருமிகள் சுவாசத்திற்குள் செல்லும்பொழுது தும்மல் மூலம் வெளியேற்றுதல், நாம் உட்கொள்ளும் ஒவ்வாத உணவுப் பொருட்களை வாந்தி, பேதி மூலம் வெளியேற்றுதல்> உடலினுள் நோய் தொற்றுகள் ஏற்பட்டால் சொறி, சிரங்குகள், தடிப்புகள் மூலம் அறிவுறுத்துதல், சத்துக் குறைபாடுகள் ஏற்பட்டால் நகங்களில் வெண்புள்ளிகள் மூலம் அறிவுறுத்துதல், இரத்தக் குறைபாடுகள் இருந்தால் கண் மற்றும் நகங்கள் மூலம் அடையாளப்படுத்துதல், புளித்த ஏப்பம் மூலம் அஜீரணத்தை வெளிப்படுத்துதல், விக்கல் ஏற்பட்டால் தண்ணீர் அருந்த அறிவுறுத்துதல், கொட்டாவி மூலம் உறக்கத்தின் தேவையை உணர்த்துதல் போன்ற பல்வேறு அறிகுறிகளின் மூலம் நமது உடலைப் பேணுவதற்கு ஆலோசனை அளிக்கும் மருத்துவராகச் செயல்படுகிறது. உடல் மொழியினை நாம் அசட்டை செய்யும் பொழுது அதன் பாதிப்பு

தீவிரமடைந்து நம்மை நோயாளி ஆக்குகிறது. அரை வயிறு உணவு, கால் வயிறு நீர், கால் வயிறு வெற்றிடம் என்ற முறையில் உணவை உட்கொள்வது ஆரோக்கிய வாழ்வுக்கு வழிவகுக்கும். எளிதில் ஜீரணிக்கக் கூடிய சரியான உணவினை முறையாக உண்டால் நோய் ஏற்படுவதைத் தவிர்க்க இயலும.; நாம் உட்கொள்ளும் உணவுகளில் கர்ப்ப மருந்தாகச் செயல்படுபவைகளில் இஞ்சி, எலுமிச்சை, நெல்லி என்ற மூன்றும் முதன்மையானவை.

இஞ்சி: தோல் நீக்கிப் பயன்படுத்தும் இஞ்சி வாதம், பித்தம், கபம் ஆகியவற்றுக்குச் சிறந்த மருந்தாகும். தேனில் ஊறிய இஞ்சி நரை, திரை, மூப்பு அகற்றுகிறது. மலேரியா நோயாளர்களுக்கு இஞ்சி, துளசி சாற்றிலே, தேன் கலந்து மூன்று நாட்கள் கொடுப்பர். நல்லெண்ணெய், இஞ்சிச்சாறு, பால் ஆகியவற்றைச் சம அளவில் சேர்த்துக் காய்ச்சிய இஞ்சித் தைலத்தை வாரம் இரு முறை தலையில் தேய்த்துக் குளித்தால் சளி, தலைபாரம், கண் எரிச்சல், காசநோய், மூக்கடைப்பு குணமாகும். தினமும் இஞ்சிச் சாற்றினைப் பயன்படுத்துதல் ரத்த அழுத்தம், வாயு தொல்லை, குமட்டல், தலை சுற்றல், மலச்சிக்கல், நீரிழிவு, அஜீரணக் கோளாறுகளை நீக்கி நலம் அடையச் செய்யும்

“இஞ்சியின் குணமே தென்றி யல்புடன் உரைக்கக் கேளீர்

அஞ்சிடும் சன்னி எல்லாம் அகன்றிடும் பித்ததோடம்

நெஞ்சினில் இருமல் கோழை நெகிழ்ந்திடும் கபங்கள்

தன்னை

மிஞ்சினி வருமோ வென்று விளம்பிடுமே தேவனூலே” [12]

சித்தர்களின் நூலில் இஞ்சியின் மருத்துவக் குணம் அதிகமாகக் கூறப்பட்டுள்ளன. நோய் அணுகாமல் காக்கும் அருமருந்தாக இஞ்சி முதன்மை பெறுகிறது.

எலுமிச்சை: இது முக்குற்றம் போக்கும் ஆற்றல் உடையது. அதாவது வாதம், பித்தம், கபம் ஆகிய மூன்றையும் சமப்படுத்தி நோய் அணுகாமல் காக்கிறது. எனவே, இதனைக் ‘கற்ப மருந்து’ என்பர். இதன் சாற்றினை நீருடனும் வேறு பழச் சாறுகளுடனும் கலந்து அருந்தும் பொழுது உடல் சூட்டினைக் குறைத்து இருமல், தொண்டை நோய்களை

அகற்றி, நச்சுக் கிருமிகளைப் போக்குகிறது. இதன் சாறு கலந்த நீரில் குளிக்கும் போது உடல் நாற்றம், சருமக் கோளாறுகள் விலகி, உடல் புத்துணர்ச்சி அடைகிறது. நீரிழிவு, வாந்தி, மயக்கம், நீ;ர்த் தாகம், நகச்சுற்று, காது வலி, கண் நோய், வாய் குமட்டல், வயிறு தொடர்பான நோய்களுக்கும் மருந்தாகிறது. எலுமிச்சையுடன் தேன் கலந்த நீர் ரத்தக் குழாயில் ஏற்படும் அடைப்புகளை நீக்கி குணமளிக்கிறது. சித்த மருத்துவர்கள் பல்வேறு மருந்துப் பொருட்களை எலுமிச்சை சாற்றிலே ஊறவைத்து வெயிலில் காய வைத்து மருந்தாகப் பயன்படுத்துவர். விலை குறைவான இப்பழத்தின் அருமை உணர்ந்து பயன்படுத்தினால் உடல் ஆரோக்கியம் பெறும்.

நெல்லிக்காய்: இனிப்பும் துவர்ப்பும் கொண்ட நெல்லிக்கனி ஒரு கற்ப மருந்தாகப் பயன்படுகிறது. வைட்டமின் சி மற்ற பழங்களைக் காட்டிலும் அதிகமாக இதில் உள்ளது. இது உடல் சூட்டினை அகற்றி, சிறுநீர், வாயு, மலம் ஆகியவற்றைச் சீர்படுத்தி வெளியேற்றுகிறது. வாந்தி, மயக்கம், தலை சுற்றல், சளி, வயிறு தொடர்பான நோய்கள், ரத்த சோகை, மூலம், மேகநோய் போன்றவற்றை நீக்கி ஆரோக்கியம் அளிக்கிறது. அதியமான் தனக்குக் கிடைத்த நெல்லிக்கனியை ஔவைக்குக் கொடுத்து புலவர்கள் தங்களை விட நீண்ட ஆயுளோடு வாழ வேண்டும் என்று விரும்பியதை புறநானூறு எடுத்துரைக்கிறது. நெல்லி, இஞ்சி, எலுமிச்சை மூன்றையும் சாறு பிழிந்து தேன் மற்றும் நீருடன் சேர்த்து அருந்தும் பொழுது பித்தம் தணிந்து இரும்புச்சத்து அதிகரிப்பதுடன் முடி உதிர்தல் கட்டுப்படும். தொற்றுகள் பரவிய நேரங்களில் மக்கள் இவற்றை மருந்தாக உட்கொண்டே நோய் அணுகாமல் தற்காத்துக் கொண்டனர். இரத்த அழுத்தத்தைச் சீராக்கி மேனி பளபளப்பிற்கும் நெல்லிச்சாறு பயன்படுகிறது. தேனில் ஊறவைத்து நெல்லி வற்றல் ஆகவும் பயன்படுத்துவர். ஊறுகாய் மற்றும் பல்வேறு உணவு பதார்த்தங்களாகச் செய்து பயன்படுத்தினால் உடலுக்கு நோய் எதிர்ப்பு சக்தி அதிகரிக்கும். ஆரோக்கியமாக வாழ உதவும்

“மூப்புளகாயம் தணிந்து மோகம் பிறக்கும் இள

மாப்பிளை போலேஅழகு வாய்க்குமே சேப்பு வரும்

கோமயமறு கரியைக் கொள்ள இரண்டு பங்கா

யாமலக முண்ண முறையால்” [13]

என்ற தேரன் வெண்பாப் பாடல் மூப்படைந்தவரும் நெல்லிக்கனியை உண்டு இளமையைப் பெற முடியும் என்பதைத் தெளிவுப்படுத்துகிறது.

சத்துக்கள் நிறைந்த காய்கறிகள், பழங்கள், பயறு வகைகள் இவற்றை முறையாகப் பயன்படுத்துவதன் மூலம் உடலை ஆரோக்கியமாகப் பராமரிக்க இயலும். இயற்கை உணவே இனிய மருந்தாக நம் வாழ்வை மேம்படுத்த இயலும்.

மருத்துவ இதழ்கள்

மக்களுக்குத் தேவையான செய்திகளைக் கூறும் ஊடகங்களில் ஒன்று இதழ்கள். இன்று வார மாத நாளிதழ்களின் எண்ணிக்கை நூற்றுக்கும் மேற்பட்டதாகக் காணப்படுகின்றன. மருத்துவக் குறிப்புகளைத் தமிழில் வெளியிடும் இதழ்களில் முதன்முதலாக கிபி 1831 ஆம் ஆண்டு‘தமிழ் மேகசின்’ என்னும் இதழ் வெளிவந்தது அதனைத் தொடர்ந்து பல்வேறு இதழ்கள் மருத்துவச் செய்திகளை வெளியிட்டாலும் நம் பாரம்பரிய மருத்துவமான சித்த மருத்துவச் செய்திகளைத் தாங்கி வரும் இதழ்கள் 1921 முதலாக வெளிவரத் தொடங்கின.

சித்த மருத்துவ இதழ்கள்	வெளிவந்த ஆண்டு	சித்த மருத்துவ இதழ்கள்	வெளிவந்த ஆண்டு
“ தமிழ் வைத்தியக் களஞ்சியம்	1921	ஆரோக்கிய தீபிகை	1924
மருத்துவன்	1928	வைத்திய களஞ்சியம்	1930
ஆரோக்கிய சிந்தாமணி	1930	வைத்தியன்	1931
சித்தர் களஞ்சியம்	1934	சித்தன்	1935
தமிழ் மருத்துவ பொழில்	1941	அகஸ்தியன்	1944
அமுது	1952	நலவாழ்வு	1956
ஞானி வைத்திய செய்தி	1959	நந்தி	1962
மூலிகை மணி	1964	மூலிகை ரகசியம்	1965
முதல் சித்தன்	1966	கிராம வைத்தியம்	1965
தமிழ் முனிவன்	1971	செந்தமிழ் சித்தன்	1974
சுகவழி	1977	சித்தாலையா	1980
சித்தர் கருவூலம்	1981	மருத்துவ மஞ்சரி	1981
சித்த மருத்துவம்	1982	கண் ஒளி	1983

கற்பக அவிழ்தம்	1986	சித்தக் கருவூலம்	1987
சித்தர் செயல்	1989	உலக சேமம்	1989
வாழ்க நலமுடன்	1989	ஓம் சக்தி மருத்துவ மலர்	1990
சித்தா உலகம்	1995	நவபாஷாண மருத்துவம்	1995
ஜீவ மூலிகை	1996	மூலிகை மருத்துவம்	1996
தெய்வீக மருத்துவம்	1997	ஞான மருத்துவமணி	1997
மூலிகை மலர்	1997	சித்தர் அறிவியல்	2000
மூலிகை குழந்தைகள்	2000	தமிழ் வைத்தியம்	2001
சித்தன் வாக்கு	வெளியான ஆண்டினை அறிய இயலவில்லை	சித்தர் வழி	வெளியான ஆண்டினை அறிய இயலவில்லை
சித்தன் குரல்	வெளியான ஆண்டினை அறிய இயலவில்லை	சித்தன் செய்தி	வெளியான ஆண்டினை அறிய இயலவில்லை”[14]

தமிழ் மருத்துவக் கல்வியின் தேவை

நமது பாரம்பரிய மருத்துவ முறைகளான சித்த மருத்துவத்தையே நாம் ‘தமிழ் மருத்துவம்’ என்கிறோம். இயற்கை பொருட்களையே மருந்துகளாகப் பயன்படுத்துவதால் பக்க விளைவுகள் இன்றி நலமடைய முடிகிறது. அலோபதி மருந்துகள் உடனடித் தீர்வாக அமைகிறது. ஆனால் நம் மருத்துவ முறைகள் நோயின் தீவிரத்தைக் குறைப்பதோடு மட்டுமல்லாது மருத்துவரின் ஆலோசனைப்படி சரியாக அதனை உட்கொண்டால் வேறு உபாதைகள் இன்றி அடியோடு அந்நோயை அகற்ற முடியும். நோய்க்கான நிரந்தர தீர்வாகவும் அமைகிறது

நம் பண்டைய மருத்துவ முறைகளை மாணவர்கள் நன்கு கற்று முறையாகப் பயன்படுத்தும் பொழுது அறிவியல் பூர்வமான உண்மைகளை உலகிற்கு எடுத்துக் கூறவும் அதனை அழிந்து விடாமல் பாதுகாக்கவும் வழி ஏற்படுகிறது. பல்வேறு மூலிகைகள் கலவைப் பொருட்களைப் பயன்படுத்தும் முறையினைக் கற்றுக் கொள்வதால் அனுபவப்பூர்வமாகத் தெளிவினைப் பெற்றுக்கொண்டு குறைந்த செலவில் நிறைந்த பயனைப் பெற இயலுகிறது.

நாடி பார்ப்பதில் தெளிவு பெற்று விட்டாலே நோய்க்கான காரணம், நோயின் தன்மை, தீர்க்கும் வழிமுறைகள், மீண்டும் நோய்

அணுகாமல் காத்தல் போன்ற வழிகளில் நோயாளிகளைப் பராமரிக்க இயலும். சிறப்பான பயிற்சி மூலம் நம்மைத் தகுதிப்படுத்திக் கொண்டால் அரசு மற்றும் தனியார் நிறுவனங்களில் வேலை வாய்ப்பு கிடைப்பது உறுதி. தனியாக மருத்துவமனைகளை உருவாக்கி நடைமுறைப்படுத்துவதற்கும் ஏதுவாகிறது. நமது மருத்துவத்தை உலகெங்கிலும் கொண்டு சென்று பல்வேறு ஆராய்ச்சிகள் மூலம் அதனை நவீனப்படுத்துவதற்கும் வாய்ப்புள்ளது

நம் நாட்டில் அரசு, தனியார் சித்த மருத்துவக் கல்லூரிகள் ஐந்து மட்டுமே உள்ளன. பள்ளிப் பாடத்தில் மாணவர்களுக்குத் தமிழ் மருத்துவ அறிவையும் ஆர்வத்தையும் ஊட்டுவதன் மூலம் மாணாக்கர் சேர்க்கையை அதிகப்படுத்தலாம். கல்லூரிகள் அதிகமாகத் தொடங்க அரசும் ஆவன செய்ய வேண்டும்.

பாடத்திட்ட நோக்கில் தமிழ் மருத்துவம்

பழமையான நம் மருத்துவக் குறிப்புகளை மீட்டெடுக்க வேண்டியது இன்றைய தலைமுறையினரின் தலையாய கடமையும் பொறுப்பும் ஆகும். எனவே, அதற்கான அடிப்படைக் கல்வியினைப் பள்ளிப் பருவத்திலே பயிற்றுவிக்கும் பொழுது உடல் நலனில் அவர்கள் அக்கறை கொள்வதுடன் எளிமையான வீட்டு வைத்தியங்கள் மூலம் நோயின்றி வாழவும் உடலைப் பேணவும் ஏதுவாக அமைகிறது.

ஆரம்பக் கல்வி:

உடற்கூறு நலமிக்க உணவுப் பொருட்கள் கால நிலைக்கேற்ப உண்ண வேண்டிய உணவுகள்> தவிர்க்க வேண்டிய உணவுகள் குறித்துக் கற்றுக் கொடுக்கலாம்.

இடைநிலைக் கல்வி:

உணவுப் பொருட்களில் அடங்கியுள்ள சத்துக்கள், எளிமையான வீட்டு வைத்திய முறைகள் (எ.கா) சளி ஏற்படின் அதிமதுரம்

(3 கட்டைகள்) பனங்கற்கண்டு (ஒரு கைப்பிடி) மிளகு (அரை கைப்பிடி) ஆகியவற்றை அரைத்து அவற்றில் சிறிதளவு மென்று சாற்றை விழுங்கினால் தொண்டை வலி, சளி, இருமல் ஆகியவற்றிலிருந்து நலம் பெற இயலும்.

உயர்நிலைக் கல்வி:

நாடி நடை குறித்த அறிமுகம், மூலிகை குடிநீர் தயாரித்தல், கஷாயம் தயாரித்தல், விஷக்கடிகளுக்கான மருந்து தயாரித்தல் (எ.கா) விஷப்பூச்சிகள் கடித்தால் இரண்டு வெற்றிலையில் ஒன்பது மிளகினை வைத்து உண்ட பின்னர் அரை மூடி தேங்காயை மென்று விழுங்கினால் விஷம் முறிந்து விடும்.

மேல்நிலைக் கல்வி:

நாடி பார்த்தல், செய்முறைப் பயிற்சி, நோய்க்கான அறிகுறிகளை அறிந்து முதலுதவி செய்யும் முறையினைக் கற்பித்தல், உணவின் மூலம் நோய் அகற்றும் வழிமுறைகளைக் கற்பித்தல் இல்ல மருத்துவராகவே அவர்களை உருவாக்குதல்.

பட்டப்படிப்பு:

அடிப்படைத் தமிழ் மருத்துவத்தின் வளர் நிலையாக அவற்றை ஆழ்ந்து கற்கும் நிலையில் பாடத்திட்டங்களை அமைத்தல், உடல் உள் உறுப்புகளின் இயக்க நிலையினையும் நோயின் தீவிரத்தைக் குறைப்பதற்குச் செய்ய வேண்டிய முதலுதவிகளையும்; கற்றுக் கொடுத்தல். இதனை முறையாக நாம் மேற்கொண்டாலே தமிழ் மருத்துவ முறைகளின் பயனை அடைவதோடு உலகெங்கிலும் அதனைக் கொண்டு சென்று இதன் வளர்ச்சி நிலையினை நாம் எட்ட முடியும். பொருளாதாரத்திலும் தன்னிறைவு அடைய இயலும்.

முடிவுரை

நாம் கற்கும் கல்வி அறிவாற்றலுடன் சிந்திக்கவும் செயல்படவும் நம்மைத் தூண்டுகிறது. நமது உடல் ஆரோக்கியத்தை மேம்படுத்தும் கல்வியை நாம் பெற வேண்டியது மிகவும் இன்றியமையாதது. இன்றைய உலகில் நோய்த் தொற்றுக்களின் பெருக்கம் நமது நிம்மதியை இழக்கச் செய்வதோடு பொருளாதாரத்திலும் நலிவடையச் செய்கிறது. இதனைத் தவிர்க்கும் முயற்சியாக நம் பாரம்பரிய மருத்துவ முறைகளைக் கற்றுக் கொண்டாலே வருமுன் காப்போம் என்ற தாரக மந்திரத்தை நடைமுறைப்படுத்த இயலும். நோயில்லாத வாழ்வே நிலைத்த செல்வத்தைக் கொடுக்கும். நிம்மதியை அளிக்கும் என்பதை அடிப்படைக் கல்வியின் மூலம் மாணவர்கள் அறிந்து கொண்டாலே நம் மருத்துவ உண்மைகளை அழியாமல்

பாதுகாப்பதோடு அதன் பயனை முழுவதுமாக அனுபவிக்க இயலும். ஆரம்ப நிலையில் பெரியவர்களின் துணையோடு இதனைக் கற்றுக் கொண்டால் பிற்காலத்தில் நோயற்ற நலமிக்க வாழ்வை அவர்களும் அவர்களது சந்ததியினரும் பெற்றுக் கொள்ள இயலும்.

அடிக்குறிப்புகள்

சு.கந்தசாமி முதலியார், உணவு மருத்துவம், ப.47

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ஆ.வேலுப்பிள்ளை, சாசனமும் தமிழும், ப.136

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https://tinyurl.com/scz4rdas

Digital Media's Impact on Socio-Familial Bonds and Intellectual Independence in College Students

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Abstract

In this advanced digital era, technology has become so integrated into daily routines that completing professional tasks or personal errands is nearly impossible without digital platforms. While these tools offer convenience, their impact on human relationships and cognitive development requires urgent attention. This study specifically focuses on the digital habits of college students, whose daily screen time has increased drastically. This trend has raised significant concerns regarding the erosion of meaningful social bonds with friends, family, and society. The primary objective of this research is to investigate the direct correlation between time spent on digital media and the resulting impact on family dynamics. Specifically, the study seeks to understand how excessive device engagement interferes with emotional connectivity and household communication. Furthermore, the research examines the escalating reliance on Artificial Intelligence (AI) for educational purposes; while AI offers undeniable academic advantages, its pervasive use is increasingly compromising students' independent thinking and original writing abilities. To achieve this, the research utilized a quantitative methodology, collecting data through a structured Google Form survey. This survey consisted of closed-ended questions designed to measure specific behaviours, such as device usage during meals, the preference for digital interaction over face-to-face conversation, and the degree of dependency on AI for academic assignments. The findings reveal that increased reliance on digital platforms systematically undermines the emotional connection between students and their families. Moreover, the data suggests that over-reliance on automated tools creates a "cognitive offloading" effect, diminishing critical analysis skills. The results conclude that as digital consumption rises, the quality of shared domestic life declines, leading to a state of "social isolation in proximity." Consequently, the research highlights an urgent need for digital ethics and value-based interventions to help students balance technological utility with the preservation of foundational human relationships and intellectual autonomy.

Keywords: College Students, Digital Ethics, Digital Media, Family Bonding, Screen Time

Introduction

The technological landscape of the twenty-first century has been defined by a series of prolific advancements and milestones that have fundamentally restructured human existence. At the epicentre of this transformation is the internet, which has emerged as the definitive gateway to global information, entertainment, and global connection. This "digital era" has facilitated unprecedented levels of accessibility, allowing individuals to harness digital media to satisfy a wide array of needs tailored to their specific age groups

and professional requirements. This paper focuses specifically on the demographic of college students and the nuances of their engagement with digital media. In the modern academic environment, students primarily utilize these platforms for a dual purpose: educational advancement and personal entertainment. The shift toward a digital-centric lifestyle was significantly accelerated by the post-pandemic landscape. During this era, pedagogical methodologies underwent a radical transition, moving away from traditional, textbook-based learning toward more fluid, digital frameworks. This includes the widespread adoption of virtual classrooms - facilitated by platforms such as Zoom and Google Meet - as well as the proliferation of mobile applications and comprehensive e-learning management systems. Furthermore, this evolution has progressed into the integration of Artificial Intelligence (AI). AI tools now serve as sophisticated assistants, helping students deconstruct complex concepts, manage academic assignments, and streamline rigorous research processes. However, this technological integration is not without its complications. The increased duration of daily digital engagement among students has precipitated a noticeable decline in physical social interaction. There is a growing, unconscious, trend of detachment from traditional social structures, including family and peer groups. As students become more immersed in virtual environments, their "real-world" interpersonal skills and overall social well-being are frequently compromised. Consequently, this study aims to examine the specific patterns of digital media usage among students and analyze the resulting impact on their ability to navigate face-to-face social dynamics and maintain healthy, grounded relationships in an increasingly digitized world.

This study is built on the belief that the constant use of digital media is fundamentally changing how college students relate to their families and how they use their minds. We hypothesize that as screen time goes up, the quality of face-to-face time with loved ones goes down, creating a sense of "being alone together" even when everyone is in the same room. Beyond social life, we expect to find that a growing dependence on AI tools for academic work is negatively affecting students' intellectual skills. By outsourcing assignments to algorithms, students may be unintentionally weakening their own ability to think critically and write creatively. In short, we argue that while technology offers convenience, it is likely a double-edged sword: it is distancing us from our most important human connections at home while simultaneously eroding the very thinking and writing abilities that define academic growth and individual autonomy.

Review of Related Literature

The deep integration of digital media into the lives of college students has completely changed how they interact, study, and think. While these tools offer great convenience, recent research reveals major downsides concerning family relationships and mental habits. This review looks at three major areas affected by constant screen time.

A major issue in modern homes is "technoference" - when digital devices interrupt face-to-face conversations (McDaniel & Radesky, 2018). This frequently happens as "phubbing" (phone snubbing), where individuals ignore the people physically around them to look at their smartphones (Chotpitayasunondh & Douglas, 2016).

Since the pandemic, student's daily screen time has jumped drastically, leading to shorter attention spans and impatient behaviours (Przybylski & Weinstein, 2024). For instance, many students now watch recreational and educational videos at 1.5x or 2x speed. While students claim this saves time, researchers find it is actually driven by boredom and a lack

of focus (Nagurney et al., 2023). This constant need for fast-paced stimulation makes students easily distracted, meaning they struggle to complete basic daily tasks without constantly checking for notifications (Rosen et al., 2013).

The rapid rise of Artificial Intelligence (AI) tools has shifted how students do college work. Instead of using their brains to process information, many students practice "cognitive offloading" - outsourcing their thinking to digital tools (Marsh & Rajaram, 2019). Passing mental work to AI blocks deep learning, which over time can weaken a student's memory and problem-solving skills (Ward et al., 2021)

Objectives

The main objective of this study is to evaluate the correlation between increased digital media consumption and its subsequent impact on the quality of familial relationships and the cognitive development of college students. To achieve this, the study focuses on the following objectives.

- To determine the average daily screen time among college students and assess how these patterns have shifted in the post-pandemic landscape.
- To investigate how often digital device usage interrupts or replaces traditional face-to-face interactions with family members, particularly during dinner time or gatherings.
- To examine the prevalence of shortened attention spans by measuring how frequently students use speed-adjustments (such as 2x speed) for educational content and the resulting impact on their patience for deep study.
- To explore the extent to which students rely on Artificial Intelligence for academic tasks and whether they perceive a decline in their own ability to think critically and write originally.

Methodology

This study adopted a quantitative research methodology to systematically investigate the evolving digital habits of contemporary college students. To achieve a comprehensive dataset, information was gathered from 70 college students using a structured survey instrument administered via Google Forms. The survey was strategically divided into five distinct categories of closed-ended questions, ensuring that the impact of digital media was evaluated across multiple dimensions of the student experience. The structure of the research instrument included the following core components:

General section established a baseline by identifying the students' average daily digital media consumption and their primary motivations for remaining online.

Family Life section questions examined the intersection of technology and domestic life, specifically investigating how digital media usage influences the quality and quantity of time students dedicate to family interactions.

Educational Life segment focused on the academic shift toward digitalization, exploring student preferences regarding various learning platforms and their integration into daily study routines.

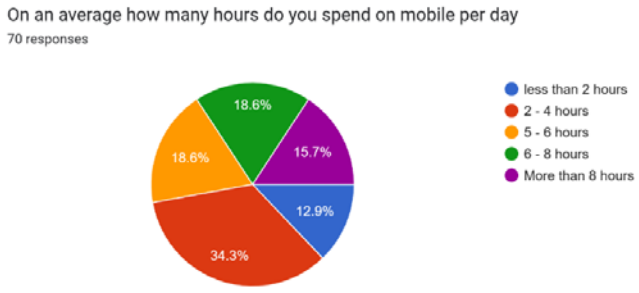
Social life section explored preferred modes of communication, analyzing how students interact with their peers and the extent to which digital tools facilitate or hinder social bonds.

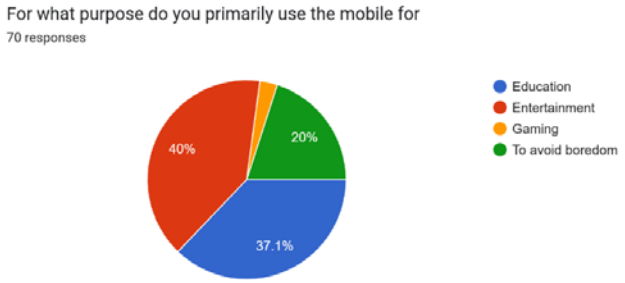
The Rating Scale helps to ensure the presence of measurable, high-precision data, a Likert-style rating section was included. Students assessed various aspects of their social, family, and academic lives on a scale of 1 to 5 (1 - Never, 2 - A few times, 3 - Sometimes, 4 - Most of the time, 5 - Always)

Findings and Discussion

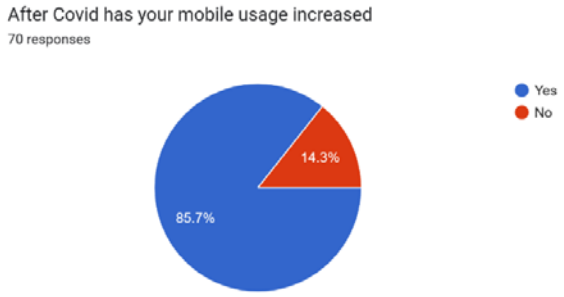
The latest survey results highlight a worrying shift in how students spend their time online, showing a massive jump in how much, they use their phones, laptops, and tablets every day. More than half of the students (52.9%) surveyed spend over five hours a day looking at screens. Even more concerning is that a some of these students (15.7%) is actually logged on for more than eight hours a day, meaning a huge chunk of their waking life is spent in a digital world.

When we look at why these students are spending so much time in online, the main reason is not for academic works. Instead, most students (62.9%) spend their time in online for entertainment purposes including gaming to avoid boredom. The data shows that less than half of the students (31.7) use digital media for education purposes.

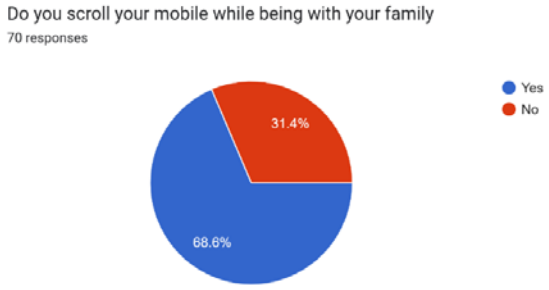




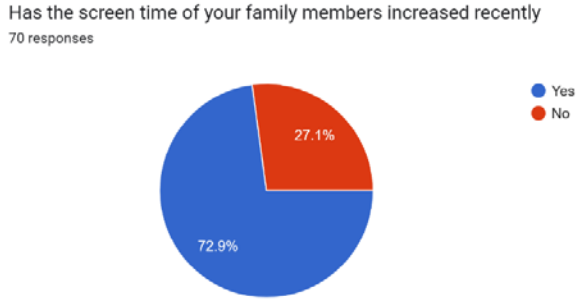
This lifestyle is a big change from how things used to be before the COVID-19 pandemic. When educational institutions closed and everyone had to stay home, technology became the only way to learn and talk to friends. However, even though life has mostly gone back to normal, the heavy use of technology has stayed the same. Almost every student (85.7%) admitted that they spend way more time on their devices now than they did before the pandemic started. What started as a necessary way to attend class from home has turned into a permanent habit. The balance has shifted, and now digital life is much more about relaxing and playing games than being productive or getting academic work done. This showcases that increased digital media consumption is the new normal now.



The findings from the "Family Life" section of the study offer a truly eye-opening and somewhat sad look at how our constant use of technology is changing the way we live at home. In our modern, fast-paced world, people are busier than ever. Between work, school, college and personal hobbies, there is very little time left for families to actually sit down and talk to one another. For most families, dinner time is the only place left in the day to spend together. It is often the only time when everyone is in the same room at once, providing a rare chance to share stories, bond emotionally, and really listen to each other. Unfortunately, the survey shows that this special time is being ruined by our phones and tablets. A huge number of students (48.3%) admitted that they are constantly scrolling through their social media feeds or checking notifications while sitting at the dinner table. When someone is looking at a screen, they aren't talking to the person sitting right next to them. This "digital interference" doesn't just happen at dinner, either. The data shows that even when families are hanging out in the living room or spending a weekend together, most of the students (68.6%) stay glued to their devices.

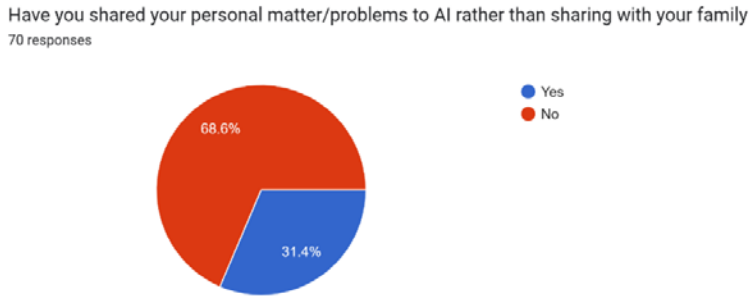


One of the most interesting parts of the study is that this isn't just problem the younger generation problem. The data suggests that parents and other adults (72.9%) in the house are also spending much more time on their phones than they used to.



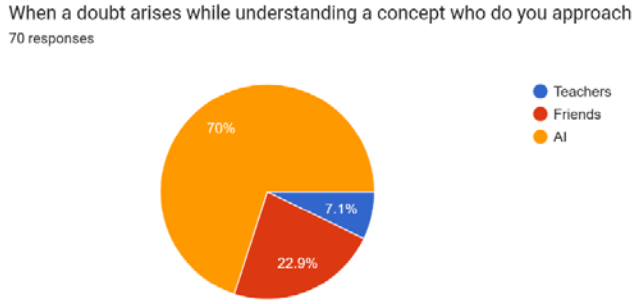
This creates a cycle where everyone is ignoring everyone else. If a parent is on their phone, the child feels it’s okay to be on theirs, and soon, the whole family is sitting in silence. The smartphone has become a physical wall that stops people from being close

to one another. The result of all this is a strange new trend called "social isolation in proximity." This basically means that even though family members are in the same room, they are worlds apart mentally. They are physically there, but their minds and hearts are somewhere else in the digital world. This habit is slowly weakening the foundation of the family. Instead of talking and playing together, people are just sitting side-by-side, staring at different screens. The traditional, strong family bond is being replaced by a home where people live together like roommates who happen to be on the same Wi-Fi, each lost in their own little digital bubble. An especially worrying discovery in this study is that a number of students (31.4%) admitted they now prefer to talk to Artificial Intelligence about their private problems instead of talking to their families. When students have a personal matter such as a secret, a worry, or a difficult emotion, they are turning to AI chatbots for advice or comfort. This is a major shift in human behaviour because, in the past, the family was the primary source of emotional support and guidance.

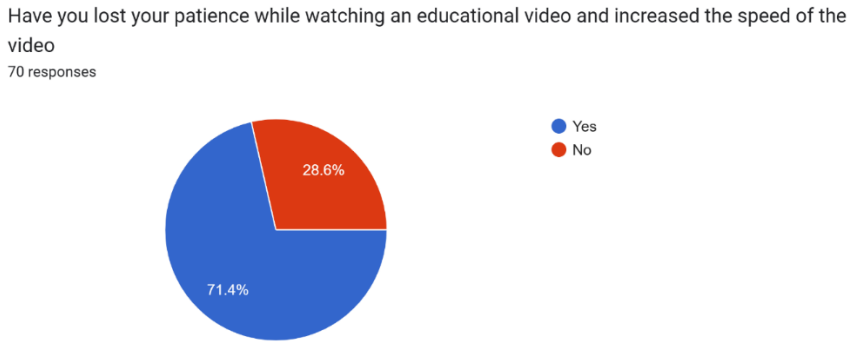


Choosing to confide in a machine rather than a parent or a sibling suggests that the deep emotional bond within the home has already started to break. It indicates that students may no longer feel comfortable, safe, or understood by the people they live with. Instead of having a heart-to-heart conversation at the dinner table, they find it easier to type their feelings into an app. This reliance on AI for emotional needs shows a serious level of detachment. It highlights a broken connection where the warmth of a family member's response is being replaced by the algorithm. This trend is a wake-up call, showing that digital tools are now filling a void that used to be held by human love and bond.

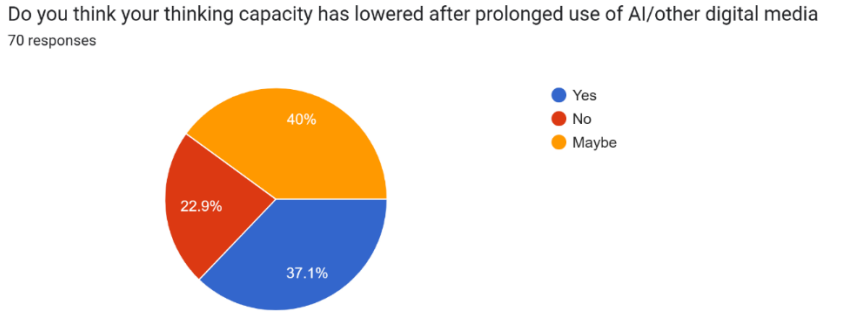
The data gathered from the Educational Life section indicates a definitive shift in student preferences, with a vast majority now favouring digital platforms over traditional academic resources. Within this digital ecosystem, Artificial Intelligence (AI) has emerged as the most utilized tool. A significant behavioural change noted in the survey is that almost all the students (70%) are increasingly bypassing traditional academic support systems; instead of consulting their peers or instructors when they encounter a conceptual challenge, they turn to AI for immediate clarification.



While this highlights the immense utility and accessibility of AI in modern pedagogy, it also reveals a concern regarding the erosion of interpersonal academic relationships. As students prioritize AI for problem-solving, the frequency of meaningful contact with teachers and classmates continues to dwindle. The transition is so profound that the data suggests traditional textbook-based learning has been largely marginalized, if not entirely replaced, by digital alternatives. However, this convenience comes with a qualitative cost. Many respondents admitted to a noticeable decline in academic patience. This is evidenced by the habit of increasing playback speeds (71.4%) while watching educational videos and relying on AI (61.4%) to summarize lengthy PDFs rather than engaging in deep reading.



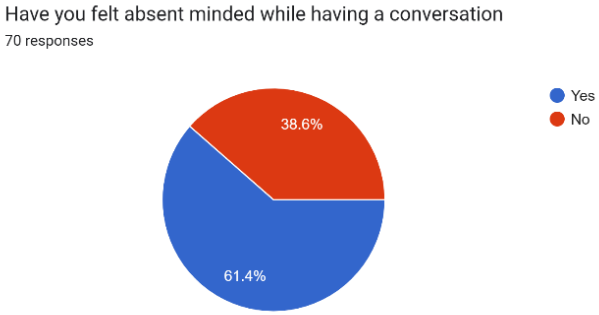
Such trends imply a desire for instant learning rather than comprehensive learning, suggesting that students are becoming less willing to invest the time necessary for critical reflection. Furthermore, the study highlights the double-edged sword of using mobile devices for study. Nearly all students (74.3%) reported that using smartphones for educational purposes inevitably leads to digital distraction, pulling their focus away from their coursework. While AI assists in the completion of assignments, the impact on cognitive development is a major concern. Most of the students (77.1%) explicitly stated that their ability to think critically and write independently has decreased due to over-reliance on these tools.



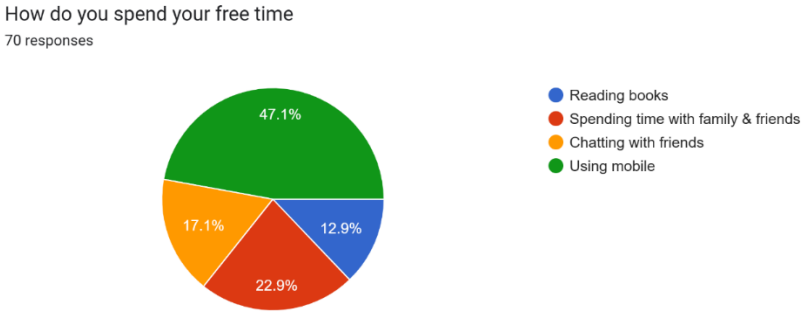
In summary, while the analysis underscores the vital role of AI in the current and future educational landscape, it also issues a warning. The pervasive use of these technologies is fundamentally altering the student experience, negatively impacting their concentration, independent thought, and communication skills. While AI provides efficiency, it may simultaneously be hindering the very intellectual rigors that traditional education is designed to foster.

The information gathered from the social section of the survey provides a deep look into how mobile devices are changing the way students interact with the people around them. A major finding is that the majority of students admit to scrolling through their phones

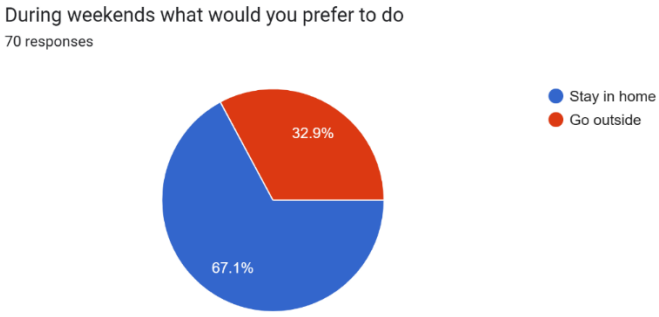
even while they are in the middle of a conversation with someone else. This habit leads to a state of absent-mindedness, where the student isn't fully listening or present.



When you aren't paying attention to the person you are talking to, it naturally weakens the friendship or bond, making the other person feel ignored or undervalued. The data also shows a shift in how students spend their downtime. Instead of using their free hours to practice a hobby, learn a new talent, or develop useful life skills, most of the students (64.2%) responded that they turn to their mobile devices.



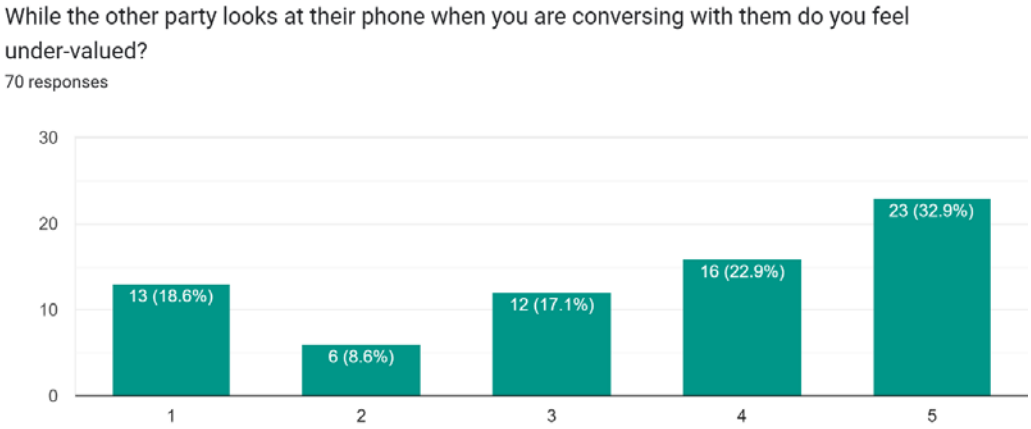
This constant digital consumption has a double-edged effect on their well-being. Physically, there is a growing concern regarding weight gain and poor fitness levels because students are sitting down for hours rather than being active or playing sports. Mentally, the lack of real-world engagement can lead to feelings of loneliness or burnout. Socially, the outside life seems to be losing its appeal. Most students (67.1%) stated that they would rather spend their weekends staying inside their homes instead of going out to catch up with neighbours or friends in person.



Also, many students now identify texting as their most comfortable way to communicate. While texting is convenient, relying on it too much makes face-to-face conversations difficult. This preference for digital messaging suggests that many students are losing their confidence in speaking in person. Because they can hide behind a screen, they aren't practicing the essential communication skills, like reading body language, making eye

contact, or speaking clearly that are needed in the real world. In short, the study indicates that while students are more connected to the internet than ever, their connection to the physical world and their ability to talk to people face-to-face is rapidly declining. This creates a cycle where they feel less capable of social interaction, leading them to retreat even further into their digital world.

The final part of the survey, which includes a rating section that combines all the previous topics, confirms a very clear and troubling trend. It shows that the amount of time students spend on their phones has grown so much that it now spills into almost every part of their daily lives. Students are no longer just using their devices when they are alone; instead, they are constantly checking them while sitting with their families, during lunch with friends, and even at large social gatherings or parties. This habit has a serious impact on how people feel when they are around these students. When you are trying to talk to someone and they keep looking down at a screen, it makes you feel like you aren't important or that what you are saying doesn't matter.



(1 - Never, 2 - A few times, 3 - Sometimes, 4 - Most of the time, 5 - Always)

This feeling of being under-valued is what slowly breaks down the trust and closeness in a relationship. Whether it is a parent trying to connect with their child or a friend sharing a secret, the presence of a smartphone acts as a barrier. The data suggests that as digital engagement goes up, the emotional bond between people goes down, making it harder for students to maintain deep, meaningful connections in the real world.

Conclusion

The comprehensive analysis of this data makes it clear that digital platforms have become an inseparable part of modern daily life. In the field of education, Artificial Intelligence has already stepped into the role of a personal tutor for many students, and this influence is only expected to grow. In the coming years, it is likely that the traditional classroom experience will rely almost entirely on AI and digital learning tools. However, this shift comes with significant drawbacks; specifically, there is a risk that the independent thinking and writing abilities of students will decline as they become more dependent on automated assistance. Beyond the classroom, the excessive use of technology is slowly eroding the essential connections between individuals and their families, friends, and wider society. Of these three, the family bond appears to be the most damaged by digital intrusion. Even when students attempt to monitor their screen time, they often lose track of how many hours they spend immersed in their devices. This leads to a serious lack of face-to-face contact, which in turn causes a decline in vital life skills such as effective

communication, patience, and high-level cognitive functions. To address these growing concerns, it is essential for students to be taught digital ethics. This involves learning how to consciously reduce screen time and prioritize human-centric values. By shifting the focus back toward real-world engagement, students can restore the meaningful bonds they share with their families and friends. Ultimately, the goal is to ensure that technology serves as a tool for progress without destroying the foundational human connections that hold a society together.

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மாணவர் திறனும் நவீனத் தொழில்நுட்பம் ஏற்படுத்தும் முரணும்

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ஆய்வுச் சுருக்கம்

நவீனத் தொழில்நுட்பங்களான சமூக வலைதளங்கள், திறன்பேசி செயலிகள், செயற்கை நுண்ணறிவு போன்றவை தற்கால மக்களிடையே பெரும் செல்வாக்கைப் பெற்றுள்ளன. இத்தகு தொழில்நுட்பங்களின் பெரு வளர்ச்சியினால் இன்று, கல்வி தொடர்பான தகவல்களை வீட்டிலிருந்தபடியே அறிந்துகொள்ளமுடிகிறது. ஆனால், இன்று பெரும்பாலான மக்கள், நவீனத் தொழில்நுட்பங்களை உள்ளடக்கிய திறன்பேசியைப் பொழுதுபோக்குக் கருவியாகவே கருதுகின்றனர். நவீனத் தொழில்நுட்பத்தை அதிகம் சார்ந்திருப்பதனாலும் இதிலுள்ள பொழுதுபோக்குக் கூறுகளுக்கு மக்கள் அடிமையாவதாலும் மனித சமூகம் பல பாதிப்புகளை எதிர்கொள்கின்றது. குறிப்பாக, மாணவர்களிடையே தகவல் தொடர்பு, சிந்தித்தல் போன்ற திறன்கள் குறைந்து வருவதனைக் காணமுடிகின்றது. திறன்பேசியின் வழி அனைத்துத் தகவல்களையும் அறிந்துகொள்ளமுடியும் என்ற

எண்ணத்தினால் மாணவர்களிடையே ஒருவித அலட்சியப் போக்கு உருவாகிக்கொண்டிருப்பதனைக் காணமுடிகின்றது. அவ்வகையில், இந்த ஆய்வுக் கட்டுரையானது, நவீனத் தொழில்நுட்பத்திற்கும் மாணவர்களின் திறன்களுக்கும் இடையே உள்ள முரண்களை ஆராய்கிறது. இத்தகு முரண்களை ஆராய்வதனால் மாணவச் சமூகம் எதிர்கொள்ளும் பாதிப்புகளையும் அப்பாதிப்புகளைக் களைவதற்கான தீர்வுகளையும் கண்டறியலாம்.

திறவுச்சொற்கள்

நவீனத் தொழில்நுட்பம், மாணவச் சமூகம், கல்வி, முரண்கள், செயற்கை நுண்ணறிவு.

முன்னுரை

மனித சமூகம் தோன்றிய காலம் தொடங்கி இன்று வரையிலும் உலகில் பலவிதமான மாற்றங்கள் நிகழ்ந்துகொண்டிருக்கின்றன. மனித சமூகம் நாகரிகம் பெற்ற பின், அச்சமூகத்தின் அறிவுத்தேடல் மென்மேலும் பெருகியது. இதன் விளைவாக, பல்வேறு படைப்புகளும் கண்டுபிடிப்புகளும் தோன்றின. அவ்வாறு மனிதர்களால் உருவாக்கப்பட்ட கண்டுபிடிப்புகளுள் சில கண்டுபிடிப்புகள் நன்மைகளையும் சில கண்டுபிடிப்புகள் தீமைகளையும் ஏற்படுத்துகின்றன. ஆனால் சில கண்டுபிடிப்புகள் நன்மை, தீமை என இருவேறுபட்ட நிலைகளைக் கொண்டிருப்பதனால் நடுநிலையான விளைவுகளை ஏற்படுத்துகின்றன. அவ்வாறு நடுநிலையான விளைவுகளை ஏற்படுத்தும் கண்டுபிடிப்புகளுள் குறிப்பிடத்தக்கவை நவீனத் தொழில்நுட்பம். செயற்கை நுண்ணறிவு போன்ற நவீனத் தொழில்நுட்பத் தளங்கள் இன்று மக்களிடையே பெரும் தாக்கத்தை ஏற்படுத்தியுள்ளன. குறிப்பாக, மாணவச் சமூகத்தில் இதன் தாக்கம்

அதிகளவு காணப்படுதனால், கடின உழைப்பை விரும்பாத, தனிமையை விரும்புகின்ற சமூகமாக அச்சமூகம் மாறி வருவதனைக் காணமுடிகின்றது. நவீனத் தொழில்நுட்பம், மாணவச் சமூகத்தில் மட்டுமின்றி மனித சமூகத்திலும் பலவகையான முரண்களை ஏற்படுத்தியுள்ளன. அவ்வகையில், நவீனத் தொழில்நுட்பத்தினால் மனித சமூகத்தில் ஏற்பட்டுள்ள முரண்களைக் கண்டறிவதோடு, நவீனத் தொழில்நுட்பத்திற்கும் மனித சமூகத்திற்கும் இடையே ஒரு சமநிலையை ஏற்படுத்துவது குறித்து இக்கட்டுரையில் காண்போம்.

ஆய்வுமுறை

நவீனத் தொழில்நுட்பத்தினால் ஏற்படும் முரண்களை விளக்கியுள்ளதால் விளக்கமுறை ஆய்வும் இணையவழிப் படிவம் (Google Form) கொண்டு தரவுகள் சேகரிக்கப்பட்டுள்ளதால் கலப்பு ஆய்வு முறையும் (Mixed Method Methodology) பயன்படுத்தப்பட்டுள்ளன. மாணவர்களை இலக்காகக் கொண்டு வடிவமைக்கப்பட்ட இணையவழிப் படிவத்தில், அணுகல் வரம்பு (Access Limitation) காரணமாக, 35 பங்கேற்பாளர்கள் மட்டுமே தங்கள் கருத்துக்களைப் பதிவு செய்துள்ளனர். இது, நவீனத் தொழில்நுட்பத்தினால் ஏற்படும் முரண்களையும் அதனைக் களைவதற்கான வழிகளையும் நோக்கமாகக் கொண்ட சிறிய அளவிலான ஆய்வுக் கட்டுரையாகும்.

மனித சமூகத்தில் நவீனத் தொழில்நுட்பத்தின் தாக்கம்

நவீனத் தொழில்நுட்பம் (Modern Technology) என்ற சொல்லுக்குப் பல பொருள்கள் இருப்பினும் இங்கு, நவீனத் தொழில்நுட்பம் என்பது சமூக வலைதளங்கள், திறன்பேசி செயலிகள், செயற்கை நுண்ணறிவு போன்றவற்றைக் குறிப்பதற்காகப் பயன்படுத்தப்படுகிறது. இன்று பலதரப்பட்ட மக்களால் பயன்படுத்தப்படுகின்ற நவீனத்

தொழில்நுட்பம், தனிமனித வாழ்க்கையில் பெரும் மாற்றங்களை நிகழ்த்தியுள்ளன. சக மனிதரோடு உரையாடுவது தொடங்கி சிந்தித்தல், கற்றல் எனப் பல நிலைகளில் நடுநிலையான விளைவுகளை (Neutral Effects) ஏற்படுத்தியுள்ளன. அதாவது, சமூக வலைதளங்கள் போன்றவற்றைப் பயன்படுத்துவதன் வழி தகவல் தொடர்பும் தகவல் பரிமாற்றமும் பெருகியுள்ளது. இதனால் மனித சமூகம் நன்மை அடைகிறது எனினும், அதே சமூக வலைதளங்களால் குடும்ப உறவுகளிடம் உரையாட மறப்பது, அச்சமூகத்திற்குத் தீங்கை விளைவிக்கிறது. இவ்வாறே, மாணவர்களின் சிந்தித்தல், கற்றல் செயல்பாடுகளிலும் நவீனத் தொழில்நுட்பம் பெரும்பங்கு வகிக்கின்றது. நன்மை விளைவிக்ககூடியதே தீமையையும் விளைவிப்பதனால் மாணவச் சமூகம் பல முரண்களை எதிர்கொள்கின்றன. இவ்வாறு நடுநிலை விளைவுகளைக் கொண்டிருப்பதோடு அதன் தேவையும் பெருகியுள்ளதனால், நவீனத் தொழில்நுட்பத்தினால் ஏற்படும் நன்மை தீமை அளவுகள் குறித்து ஆராய்வதை விட, அவை மாணவச் சமூகத்தில் ஏற்படுத்தும் முரண்கள் குறித்து ஆராயப்படவேண்டும். இத்தகு முரண்களை ஆராய்வதனால் மாணவர்களிடையே நவீனத் தொழில்நுட்பத்தினால் ஏற்படும் பாதிப்புகளைக் கண்டறிவதோடு அப்பாதிப்புகளைக் களைவதற்கான வழிகளையும் கண்டறியலாம்.

கற்றலில் நவீனத் தொழில்நுட்பத்தின் பங்கு

திறன்பேசி (Smartphones) அறிமுகமான காலக்கட்டங்களில், வீட்டிற்கு ஒரு திறன்பேசி அல்லது திறன்பேசியே இல்லாத நிலை போன்ற சூழல்களே நிலவியது. ஆனால் இன்று பள்ளிப்பருவ மாணவர்கள் கூடத் தனக்கெனத் தனித் திறன்பேசி கொண்டுள்ளனர். கற்றல் சார்ந்த

விடயங்களுக்காகத் திறன்பேசியைப் பயன்படுத்துவது ஒருபுறம் இருக்க, இது பெரும்பாலும் மாணவர்களிடையே கவனச்சிதறலையே ஏற்படுத்துகின்றது. அவ்வகையில், மாணவர்கள் திறன்பேசியில் பயன்படுத்தும் செயலிகளைப் பின்வருமாறு வகுக்கலாம்.

- தகவல் தொடர்புச் செயலிகள் (Communication Apps)
- பொழுதுபோக்குச் செயலிகள் (Entertainment Apps)
- விளையாட்டுச் செயலிகள் (Gaming Apps)

இவற்றுள் தகவல் தொடர்புச் செயலிகளான புலனம் (Whatsapp), தொலைவரி (Telegram) போன்றவற்றையும் பொழுதுபோக்குச் செயலிகளான வலையொளி (Youtube), படவரி (Instagram), முகநூல் (Facebook) போன்றவற்றையும் மாணவர்கள் கல்வி தொடர்பான விடயங்களுக்காகப் பயன்படுத்துகின்றனர். இவற்றோடு இச்செயலிகளில் இடம்பெற்றுள்ள பிற பொழுதுபோக்குக் கூறுகளையும் பயன்படுத்துகின்றனர். தங்கள் கல்வி தொடர்பான தகவல்களையும் குறிப்புகளையும் பகிர்ந்துகொள்ள புலனம், தொலைவரி போன்ற செயலிகளைப் பயன்படுத்துகின்றனர். மாணவர்கள், தங்கள் பாடம் தொடர்பான ஐயங்களைக் களைவதற்கும் அதில் மென்மேலும் தெளிவு பெறுவதற்கும் வலையொலியில் பிறரால் பதிவேற்றப்பட்ட காணொளிகளைப் பயன்படுத்துகின்றனர். படவரி, முகநூல் போன்றவற்றிலும் பிறரால் பதிவேற்றப்பட்ட கல்வி தொடர்பான குறு காணொளிகள் (Short Videos) காணப்படுகின்றன. பெரும்பாலான மாணவர்கள் குறு காணொளிகளையே விரும்புகின்றனர். குறிப்பாக, பிற மொழி வார்த்தைகளையும்

வாக்கியங்களையும் கற்றுத் தருகின்ற குறு காணொளிகளை மாணவர்கள் மட்டுமின்றி பெரியவர்களும் விரும்பிப் பார்க்கின்றனர்.

கற்றில னாயினுங் கேட்க அஃதொருவற்கு
ஒற்கத்தின் ஊற்றாந் துணை
(குறள். 414)

என்ற குறளுக்கிணங்க, மாணவர்கள் பார்த்துக் கற்பதை விட, செவிவழிக் கற்றலைப் பெரிதும் விரும்புகின்றனர். அவ்வகையில், செவிவழிக் கற்றலை ஊக்குவிக்கின்ற ஒலிப்புத்தகங்கள் (Audio Books), மாணவர்களின் பெரும் மதிப்பைப் பெற்றுள்ளன. ஒலிப்புத்தகங்களுக்கான செயலிகளில் கல்வி தொடர்பான புத்தகங்கள், சிறுகதை, புதினம் போன்ற பொழுதுபோக்கு சார்ந்த புத்தகங்கள் எனப் பலவகையான ஒலிப்புத்தகங்கள் காணப்படுகின்றன. விளையாட்டுச் செயலிகளுள் பொழுதுபோக்கிற்கான செயலிகள் மட்டுமின்றி கற்றல் சார்ந்த செயலிகளும் காணப்படுகின்றன. கணக்கு, மொழி போன்றவற்றை விளையாட்டுக்கள் வழி கற்பதற்குப் பல செயலிகள் உள்ளன. இச்செயலிகளைப் பயன்படுத்துவதனால் புத்துணர்ச்சி ஏற்படுவதோடு மென்மேலும் கற்பதற்கான ஆர்வமும் பெருகுகிறது. ஆனால், பெரும்பாலான மாணவர்கள் கற்றல் சார்ந்த விளையாட்டுச் செயலிகளில் ஆர்வம் காட்டுவதில்லை. மாறாக, பொழுதுபோக்கு சார்ந்த விளையாட்டுச் செயலிகளையே பெரிதும் விரும்புகின்றனர்.

இவைதவிர, இன்று மக்கள் பரவலாகப் பயன்படுத்தப்படுகின்ற செயற்கை நுண்ணறிவு (Artificial Intelligence), மக்களிடையே பெரும் வரவேற்பைப் பெற்றுள்ளது. செயற்கை நுண்ணறிவு என்பது மனிதர்களைப் போலவே சிந்தித்தல், கற்றல் போன்ற திறன்களைக் கொண்ட ஒரு நவீனத் தொழில்நுட்பமாகும். ஒரு விடயம் குறித்து

அறிந்துகொள்ள பல வலைத்தளங்களைப் பார்க்கவேண்டிய நிலையில், செயற்கை நுண்ணறிவு, அத்தகவல் குறித்துப் பல வலைத்தளங்களையும் ஆய்ந்தறிந்து ஒரு முடிவைத் தருகிறது. இதனால் குறுகிய நேரத்தில் தெளிவான புரிதல் ஏற்படுகிறது. ஒரு தகவலைத் தேடுவதற்காக மட்டுமின்றி,

- தேர்வுக்குத் தயார்செய்தல்
- மொழிபெயர்த்தல்
- ஒப்படைப்புகள் எழுதுதல்

போன்ற நோக்கங்களுக்காகவும் மாணவர்கள் செயற்கை நுண்ணறிவைப் பயன்படுத்துகின்றனர்.

தேர்வுக் காலங்களில் மாணவர்கள் தங்கள் பாடங்களைக் குறுகிய நேரத்தில் படிப்பதற்காகவும் எளிதில் புரிந்துகொள்வதற்காகவும் செயற்கை நுண்ணறிவின் உதவியை நாடுகின்றனர். பாடப்பகுதிகளின் தலைப்புகள் மட்டுமின்றி புத்தகத்திலுள்ள பாடப்பகுதிகளைப் புகைப்படம் எடுத்துக் கொடுத்தாலும் அதனை விரைவாகப் புரிந்து, கற்று சுருக்கமாகத் தொகுத்தளித்துத் தருகின்றது. அவ்வாறே, ஒப்படைப்புகள் எழுதுவதற்கும் நிறைய கருத்துக்களையும் யோசனைகளையும் எடுத்துரைத்து உதவி செய்கிறது. செயற்கை நுண்ணறிவு, பல மொழிகளை அறிந்திருப்பதனால் மொழிபெயர்ப்புக்காகவும் பயன்படுத்துகின்றனர். நாம் கொடுக்கும் வாக்கியத்தை மொழிபெயர்த்துத் தருவதும், நாம் மொழிபெயர்க்கும் வாக்கியத்தைத் திருத்தவும் செய்வதோடு அவ்வாக்கியத்தை, அதே பொருளில் வேறுவிதமாக மாற்றியமைப்பதற்கான பரிந்துரைகளையும் எடுத்துரைக்கிறது. இவ்வாறு இன்றைய நவீனத் தொழில்நுட்பம், கல்வி கற்கும் மாணவர்களுக்குப் பலநிலைகளில் உதவிகரமாகச்

செயல்படுகிறது. அதேசமயம், இதில் பல பொழுதுபோக்குக் கூறுகளும் காணப்படுவதனால் கற்றலை விட பொழுதுபோக்குக் கூறுகளுக்காகவே மாணவர்கள், திறன்பேசியை அதிகம் பயன்படுத்துகின்றனர்.

நவீனத் தொழில்நுட்பங்களும் முரண்களும்

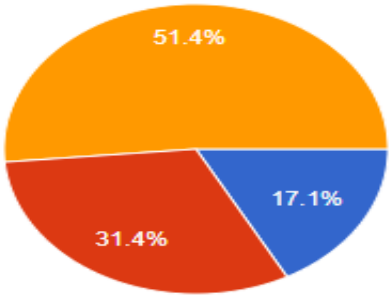
மாணவர்கள் தங்களுக்கெனத் தனித் திறன்பேசி வைத்திருப்பது இன்றைய கல்விச்சூழலில் மிகவும் அவசியமானதாகக் கருதப்படுகிறது. அதிலும் சில கல்வி நிறுவனங்கள், மாணவர்கள் தங்களுக்கெனத் தனித் திறன்பேசி வைத்திருக்கவேண்டும் என வலியுறுத்துகின்றன. இவ்வாறு திறன்பேசியின் தேவை பெருகிவிட்ட நிலையில், அவை மனித செயல்பாடுகளில் ஏற்படுத்தும் முரண்களையும் கவனிக்கவேண்டும். அவ்வகையில்,

- தகவல் தொடர்பு (Communication)
- கற்றல்
- சிந்தித்தல்

போன்ற செயல்பாடுகளில் நவீனத் தொழில்நுட்பம் பெரும் தாக்கத்தையும் முரண்களையும் ஏற்படுத்தியுள்ளது.

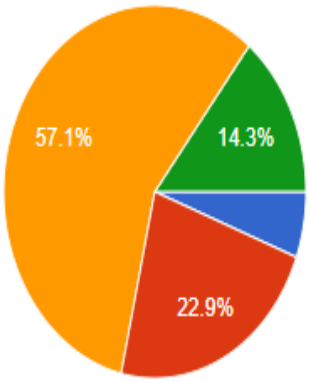
சமூக வலைதளங்கள் போன்ற செயலிகளின் பெரு வளர்ச்சியினால் நண்பர்கள், உறவினர்கள் மட்டுமின்றி தொலைதூரத்திலுள்ள மனிதர்களையும் எளிதாகத் தொடர்புகொள்ளமுடிகிறது. இது தகவல் தொடர்பை (Communication) எளிதாக்குவதோடு நாடு, மொழி கடந்து மக்களோடு தொடர்பு ஏற்படுத்திக்கொள்ள வழிவகை செய்கிறது. இவ்வாறு சமூக வலைதளங்கள் இணையவழித் தகவல் தொடர்பை (Online Communication) மேம்படுத்தியிருந்தாலும், சக மனிதனுடனான நேரடித் தொடர்பு குறைந்து வருவதற்கும் காரணமாக அமைகிறது. பெரும்பாலான மக்களுக்கு, ஒரு நபரோடு சமூக வலைதளங்களில்

பேசுவது எளிதாகவும் அதே நபரோடு நேரடியாகப் பேசுவது சற்றுக் கடினமாகவும் உள்ளன.



மேற்குறித்த படிவத்தில் 51.4% பேர் (18 நபர்கள்) இணையவழித் தகவல் தொடர்பை (Online Communication) விட, நேரடித் தகவல் தொடர்பு சற்றுக் கடினமாக இருப்பதாக உணர்கின்றனர். இவ்வாறு, தகவல் தொடர்புக் கருவிகள் பெருகிவிட்ட இன்றைய சூழலிலும் கூட, சக மனிதனுடனான நேரடித் தொடர்பு குறைந்து வருவது கவனிக்கத்தக்கதாகும். இது மக்களிடையே உள்ள பிணைப்பைக் குறைத்துத் தனிமையை விரும்பும் நிலையை ஏற்படுத்துகிறது.

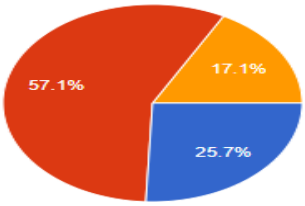
இன்றைய காலக்கட்டத்தில், கல்வி தொடர்பான தகவல்களை வீட்டில் இருந்தபடியே அறிந்துகொள்ள முடிகிறது. மாணவர்கள், தங்கள் பாடம் தொடர்பான தேவையான தகவல்கள் புத்தகத்தில் இருந்தாலும்கூட, உடனுக்குடன் அறிந்துகொள்ள வேண்டி, நவீனத் தொழில்நுட்பத்தைப் பயன்படுத்துகின்றனர். இது குறுகிய நேரத்தில நல்ல புரிதலை ஏற்படுத்துகிறது. எனினும், மாணவர்களிடையே புத்தகம் படித்துக் கற்கின்ற ஆர்வம் குறைந்து வருவதனையும் காணமுடிகின்றது. தேடிப் படிக்க வேண்டும் என்ற ஆர்வமும் இன்றைய மாணவரிடையே மறைந்து வருவதனை இதன்வழி அறியமுடிகிறது.



மேற்குறித்த படிவத்தில், கற்றல் சார்ந்த விடயங்களுக்காக நவீனத் தொழில்நுட்பத்தைப் பயன்படுத்தத் தொடங்கிய பின், 57.1% பேர் (20 நபர்கள்) புத்தகம் பயன்படுத்துவதைக் கடினமாக உணர்வதாகக் குறிப்பிடுகின்றனர்.

ஒரு தகவலை அறிந்துகொள்வதற்கும் வினாவிற்கான விடையைத் தெரிந்துகொள்வதற்கும் நவீனத் தொழில்நுட்பத்தினைப் பயன்படுத்துகின்றனர். இது விரைவாகச் செயல்படுவதோடு தேர்ந்த பரிந்துரைகளையும் (Suggestions) வழங்குகிறது. இவ்வாறு நவீனத் தொழில்நுட்பம் மாணவர்களுக்குப் பயனுள்ளதாக இருக்கிறது எனினும் இது அவர்களின் சிந்தனைத்திறனைப் பாதிக்கிறது. எளிய தகவலாயினும் கணநேரத்தில் மறந்த விடையாயினும் அதை முயற்சி செய்து சிந்திக்கும் பொறுமை இன்று பலரிடையே இல்லை. மாறாக, எதையும் உடனே அறிந்துகொள்ளவேண்டும் என்ற ஆவலே காணப்படுகிறது. ஒரு குறிப்பிட்ட தலைப்பில் கட்டுரையோ அல்லது ஒப்படைப்போ எழுத முற்படும் மாணவர்கள், தாங்களே சிந்தித்து சில கருத்துக்களை எழுதினாலும் பெரும்பாலான வேளைகளில் நவீனத் தொழில்நுட்பத்தின் உதவியையே நாடுகின்றனர். குறிப்பாக, செயற்கை நுண்ணறிவைப் பயன்படுத்தி எழுதும்போது,

மாணவர்களின் சொந்த கருத்துக்களைவிட செயற்கை நுண்ணறிவின் கருத்துக்களே அதிகம் இடம்பெறுகின்றன. இதனால் சில நேரங்களில், மாணவர்கள் அக்கட்டுரையைத் தங்களுடைய படைப்பாக உணர்வதில்லை.



மேற்குறித்த படிவத்தின் அடிப்படையில், 25.7% பேர் (9 நபர்கள்) செயற்கை நுண்ணறிவைப் பயன்படுத்தி எழுதியதைத் தங்களுடைய படைப்பாக உணர்ந்ததில்லை என்பதனை ஒப்புக்கொள்கின்றனர். இவ்வாறு நவீனத் தொழில்நுட்பத்தைப் பயன்படுத்தி எழுதுவதால், மாணவர்களின் ஆக்கபூர்வமான சிந்தனைகள் வெளிப்படுவது தடைபடுகிறது.

தீர்வுகள்

மனித சமூகம், திறன்பேசியின் அடிமையாகாமல், அதனை அளவாகப் பயன்படுத்துவதே சிறந்த தீர்வாகும். சமூக வலைதளங்களிலுள்ள உறவுகளைவிட, நம் அருகிலிருக்கும் உறவுகளுக்கு முக்கியத்துவம் கொடுத்துப் பேச வேண்டும். ஏனெனில், நேரடித் தகவல் தொடர்பில் உணர்வுபூர்வமான உரையாடல் நிகழ்வதோடு பேசுபவருடைய உண்மையான உணர்வுகளையும் புரிந்துகொள்ளமுடிகிறது. சமூகவலைதளத்தில் நன்றாகப் பேசிய நபரோடு நேரடியாக பேசச் சங்கடப்படும் நிலையில், அந்நபரிடம் அதனைத் தெரியப்படுத்துவது நல்லது. இதனால் இருவருக்குமிடையிலான உரையாடல் எளிதாவதோடு அவர்களின் உறவுநிலையும் வலுப்படுகிறது.

மாணவர்கள், திறன்பேசியை அளவாகப் பயன்படுத்தவேண்டிய பொறுப்பினை வளர்த்துக்கொள்ள வேண்டும். ஒரு விடயம் குறித்து நமக்குத் தோன்றுகின்ற சிந்தனைகள் சரியானவையா என அறிந்துகொள்ளவும் மொழிபெயர்ப்புக் குறித்த ஐயங்களுக்கும் செயற்கை நுண்ணறிவு போன்ற நவீனத் தொழில்நுட்பங்களைப் பயன்படுத்தலாம். எல்லா சமயங்களிலும் திறன்பேசியின் உதவியை நாடாமல் ஆசிரியரைக் கேட்டும், புத்தகத்தைத் தேடிக் கற்றும் படிக்கின்ற பழக்கத்தினை ஏற்படுத்திக்கொள்ளவேண்டும்.

மாணவர்களை நெறிப்படுத்த வேண்டிய பொறுப்பு பெற்றோர்களுக்கு உண்டு. 65% பெற்றோர்கள், தங்கள் பிள்ளைகள் அதிகளவு திறன்பேசியைப் பயன்படுத்துவதாகக் குறிப்பிடுகின்றனர். தங்கள் பிள்ளைகள் எவ்வளவு நேரம் திறன்பேசியைப் பயன்படுத்துகின்றனர் என்பதனைப் பெற்றோர்கள் கண்காணிக்கவேண்டும். திறன்பேசியைப் பயன்படுத்துவதற்கெனத் தனி நேரத்தை ஒதுக்கி, அந்த நேரத்தில் மட்டுமே திறன்பேசியைப் பயன்படுத்த அனுமதிக்கவேண்டும். மாணவர்களை நெறிப்படுத்துவதில் ஆசிரியர்களின் பங்கு அளப்பரியது. நவீனத் தொழில்நுட்பங்களின் உதவியின்றி படிக்கவும் எழுதவும் மாணவர்களை ஊக்குவிக்கவேண்டும். நூலகத்திலுள்ள புத்தகங்களைத் தேடிப் படிக்கும் வகையிலும் புத்தக வாசிப்பை ஊக்குவிக்கின்ற வகையிலும் ஒப்படைப்புகள் அமையவேண்டும். மாணவர்களிடையே நேரடித் தொடர்பினை ஏற்படுத்தும் வகையில் குழு விவாதங்களை ஏற்படுத்தவேண்டும். இதனால் சிந்திக்கின்ற திறனும் அதிகரிக்கும்.

முடிவுரை

நவீனத் தொழில்நுட்பம், தேவைக்காகப் பயன்படுத்தத் தொடங்கி, இன்று அத்தியாவசிய பயன்பாடாக உருவெடுத்துள்ளது. அனைத்து தகவல்களையும் உள்ளடக்கிய ஒரு கருவியைக் கொண்டுள்ளதனால் எந்தவொரு தகவலையும் செய்தியையும் நினைவில் வைத்துக்கொள்ளாது, திறன்பேசியை நம்பி வாழ்கின்ற, ஒரு அலட்சியப் போக்குடைய மனித சமூகம் உருவாகிக்கொண்டிருப்பதனைக் காணமுடிகின்றது. திறன்பேசியையும் அதிலுள்ள நவீனத் தொழில்நுட்பத்தையும் அதிகம் சார்ந்திருக்காமல், தேவையறிந்து பயன்படுத்துகின்ற திறன் மனித சமூகத்திடம் உள்ளது. அத்திறனை மென்மேலும் வளர்த்துக்கொண்டு ஒரு அறிவார்ந்த சமூகமாக உருவாவதோடு வரும் தலைமுறையினர், அத்திறனையும் அறிவையும் பெற வழிவகை செய்யவேண்டும்.

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From Legacy to Short-Form: How Short-Video Platforms Transform the Communication Strategies of Professional Media Organisations in the Digital Era

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Abstract

Short-video platforms have transformed professional media organisations' communication tactics by providing visually appealing and concise material in short videos. Traditional media has struggled in recent years due to a lack of understanding of new communication tactics. The research aimed to examine the interaction between short-video platforms and media organisations' communication strategies in this technologically changing business environment. A cross-sectional and quantitative research methodology collected data from selected 778 media professionals from Chinese media organisations. This research used purposive sampling and distributed survey questionnaires to evaluate basic data using descriptive analysis. Analysis of Variance (ANOVA) was employed to examine the connection between short-video platforms and professional media organisations' digital communication methods. The findings showed that professional media organisations' communication tactics are affected by short-video platforms. This change promoted rapid content dissemination and audience interaction to shape user behaviour and communication patterns. In conclusion, short video platforms are essential for professional media companies to stay competitive and increase business applicability.

Keywords: Communication Strategies, Digital Media, Professional Media Organisations, Short-Video Platforms

Introduction

Short video platforms have become a distinguishing characteristic of the modern digital age, creating a potent marketing communication channel for different businesses. These short video platforms are disseminated through a variety of new media channels, where content is regularly promoted to consumers by algorithm-driven systems. Short videos, which usually last a few seconds to a few minutes, are intended to provide clear, interesting, and quickly assimilated information. Their transmission expansion reflects changes in consumer requirements, especially the need for easily available information that can be seen in short bursts. The short video shooting and editing software is constantly updated and upgraded due to the market's needs. The quality of short videos is also constantly improving (Han, 2022). Traditional media outlets have historically relied on long-form content. These media platforms are progressively shifting toward short-form content in the digital era. This transformation reflects the shifting requirements of viewers among younger users who demand visually appealing and quick forms.

Audiences are increasingly favouring rapid and personalised content in the digital information era. Traditional broadcasting tactics are no longer the sole choice for professional media businesses in China. They are passively improving content that is data-informed and interactive exclusively for digital viewers (Tan, 2023).

Short-form video allows organisations to communicate information in easily digestible parts. Subjects that traditionally necessitated lengthy essays or extensive presentations can now be introduced through a series of concise movies, each focusing on a singular subject. This divided method facilitates continuous communication instead of depending on one comprehensive content piece. China has emerged as a crucial player in the methods of reinventing media communication in the modern digital period in the rapid development of platforms that host short videos (Riaz, 2025). Chinese media companies have also been deliberately including short-video storytelling to increase audience impact and involvement in this atmosphere. Moreover, the transformation of professional media organisations in China from legacy designs to short-form communication has been pushed forward by platform-specific trends. These changes have also been accelerated by algorithm-driven distribution (Meng & Zhao, 2023). Chinese platforms for short videos that use algorithmic recommendation technology to represent audiences with relevant short videos. These platforms enable them to rapidly locate content that visitors find enjoyable with a vast array of video options. The speed and manner of communication in the digital age have altered audience participation, becoming more instantaneous and participatory. Consequently, platforms for short videos have forced media creators to use tailored, data-driven communication methods. Additionally, the shift from heritage to the culture of short-form videos represents a reconfiguration of media power to audience engagement and information delivery (Zhang et al., 2026).

Review of Related Literature

Numerous academic fields, such as media studies, marketing and technology, have thoroughly examined the emergence of short-video platforms. Researchers have investigated its impacts on audience engagement, digital marketing tactics, and content consumption. This review of the literature looks at significant research that sheds light on the development and future direction of short-form video. Guo and Sun (2023) emphasised in their research that some short video platforms are usually thought of as platforms used for sharing picture and visual content. They also highlighted that previously known reels were frequently used news consumption strategies among generations of youth. The research study has indicated that despite the requirement of newspaper publication authorities to utilise the visual content of the distinct platform. Combined with the numerous studies, research indicated that it is significant to maintain the content quality of professional media organisations that are posted by news publishers online. Additionally, they also indicated that news publishers benefited from this equilibrium as it increased overall audience engagement (Guo & Sun, 2023). Similarly, some previous analyses emphasised that high user impact and sophisticated online platform frameworks make a special example for professional media organisations. Different internet-based communities have improved worldwide due to their tremendous financial backing. The networking platform of the new digital era is an important catalyst for short video platforms. It is also helping to facilitate efficient information distribution through machine learning methods and big data analytical methods. In cultural tourist-related advertising, short video media platforms are becoming innovative platforms and methodologies for developing the image of Chinese tourists (Li & Liu, 2023).

On the other hand, Research by Yang (2024) demonstrated that short-form video is primarily subject to the growing number of commercial systems in China, where user engagement determines the popularity of content. Brands must employ a variety of ways to execute their marketing plans based on the short-form video platform due to the expansion of big data in the new digital era. Research indicated that brand placement is always the first step in the new digital era for content to be heavily promoted on short-form video (Yang, 2024). The findings supported previous research conducted by Yu (2025) professional media businesses are gradually applying simple narrative compression and short, visually appealing films. The study indicated that short films use soundtracks, visual effects, and language subtitles to create a conversational approach by replacing textual structures with visual speed. This study has explored the efficiency of short movies in meeting customers' desires to read information in the new digital era. According to this study, Chinese media organisations, more specifically, those connected to the government to manage their official online profiles on media platforms aggressively and produce regular content to maintain their importance (Yu, 2025).

According to Agenda-Setting Theory by McCombs and Shaw (1972), the way mass media prioritise individual topics over others affects general perceptions. The thesis suggests that the media’s concentration modifies social objectives. The theory indicates that when the professional media cover specific subjects, society views those subjects as being of complete significance. If the professional media organisations choose to focus on one subject over another, the entire trajectory of the discourse of the nation may change. According to the Agenda-Setting Theory, a society's perception of an issue's significance increases with the frequency of professional media coverage. Mass media greatly influence people’s thoughts and feelings about topics that affect their lives. In another way, the theory reveals that the media influences people's thoughts (McCombs & Shaw, 1972). In the new digital era, Agenda-Setting Theory represents a useful lens for the transformation of short-video platforms in the communication strategies of professional media. The role has shifted to an algorithm-driven and participatory model after the rise of digital platforms. The engagement of the user and platform logics determines the significance of the content rather than solely editorial decisions in the new digital era. In summary, the relationship with Agenda-Setting Theory is that short video platforms transform their schedule to an algorithm-driven, dynamic one. Professional media transform their communication strategies around trends and the logic of the platform (Liu, 2024). Therefore, Agent-Setting Theory remains significantly relevant between the short-video platforms and communication strategies of professional media organisations in the new digital era of audience-centred methods and algorithm-driven digital communication.

Objectives

- To evaluate the influence of short-video platforms on the communication strategies of professional media organisations, as mediated by the digital era.

Methodology

Research Design and Procedure

A cross-sectional, quantitative research design was used in the current research to analyse the role of short-video platforms on the communication strategies of professional media organisations as mediated by the new digital era. The study promoted the collection of data from 778 media professionals of Chinese media organisations to assess patterns

while evaluating the relationship between research variables. Both the online and offline structured questionnaires were distributed to appropriate responders to complete the data collection. A pilot test was used to confirm the validity of the data, while Cronbach's Alpha was implemented for proper evaluation of reliability. To sufficiently assess the measurable relationships between the short-video platforms and the communication strategies of professional media organisations in the mediating role of the new digital era. The current study was a distributed survey questionnaire to the chosen study sample. Researchers applied 95% confidence intervals to assess the statistical relationship between direction and strength. The statistical significance was set at a p-value of less than 0.05. The researcher also used descriptive analysis to determine the key elements of the data of this study.

Operational Framework

Subjects or Data Sources

A survey will be carried out to collect primary data for this study's analysis. Media specialists from Chinese media organisations in Guangdong province were supplied with data for the study. The survey will be divided into two parts: (a) the respondents' personal information and (b) a 5-point Likert scale with questions about how short-video platforms in the present digital environment affect the communication strategies of the professional media.

Instrumentation and Data Analysis

The purposive sampling technique was applied in the study to select valid and relevant study respondents in the research context. Raosoft tool suggested 710 research participants for the data collection of the study. Henceforth, 860 survey questionnaires were distributed to the respondents. Researchers received 810 questionnaires, from which 32 questionnaires were rejected because of unprofessional or insufficient responses. Therefore, the final sample size was 778. Microsoft Excel and SPSS version 25 were implemented for statistical analysis in the research investigation. The researcher to understand the key elements of the data, even though ANOVA was used to assess the collected data, applied a descriptive analysis.

Limitations

The use of closed-ended survey questions in this digital age prevented respondents from giving thorough explanations. This type of limitation restricted the ability to capture nuanced opinions or contextual factors influencing respondents' experiences of the impact of short-video platforms. The relationships between the variables under study were oversimplified by the quantitative data. In addition, collecting data exclusively from Chinese media sources could result in issues with how generalised conclusions were presented in different geographical contexts. The cross-sectional approach may limit the ability of researchers to demonstrate causation because the data reflected relationships at a single moment in time rather than changes over time. Finally, the results may not be

completely generalisable outside of the population under research, as the short-video platforms on the communication strategies of professional media businesses influenced them, and the mediation of the modern environment, which was only included in the study.

Analysis

- **Factor Analysis**
  The goal of factor analysis (FA) is to recognise hidden patterns in otherwise accessible data. This analysis is frequently used where visual indicators are not sufficient to describe the complex relationships among variables in the study. The goal of the simulation is to identify weaknesses, violations, and potential linkages that are visible to the unaided eye. The “Kaiser-Meyer-Olkin (KMO) Test” is applied to evaluate the sufficiency of sampling data and the usefulness of data for FA. It has been shown that the mathematical model and associated variables used for sampling yield accurate results. Duplicate patterns might be found within the data, and these patterns become more apparent when the proportions are reduced. KMO give the investigator a number between 0 and 1 to support the study. An adequate sample population is determined by a KMO value between 0.8 and 1.

  Kaiser claims that the following criteria have been considered as the parameters that are suitable: Kaiser must meet the following certification requirements:
  Middle grades normally range from 0.70 to 0.79; a pitiful range, 0.050 to 0.059; far below the usual range of 0.60 to 0.69.
  A quality point rating between 0.80 and 0.89. They are surprised at the range of 0.90 to 1.00.
  Table 1: Examination of KMO and Bartlett's Sampling Adequacy
  According to the KMO scale: 0.961
  The approximate Chi-Square value: 4910.150.
  190 is degrees of freedom (df); sig. = 0.000.

Table 1: KMO and Bartlett's Test

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.961
Bartlett's Test of Sphericity	**Approx. Chi-Square**	4910.150
	df	190
	Sig.	0.000

Using the "Bartlett's Test of Sphericity" Test, the researchers determined if the correlation matrices were statistically significant. If the KMO score was 0.961, the sample size was considered sufficient. The p-value was 0.00 according to Bartlett's Test of Sphericity. Therefore, the significant outcome obtained from Bartlett's Test of Sphericity which is indicated that the correlation matrix is not an identity matrix.

Independent Variable

- **Short-Video Platforms**

  Short video platforms have emerged as an essential function in shaping user management and preferences in e-commerce. These platforms improve their video quality to establish themselves as the top channels for brands to connect with customers and influence their buying decisions in the digital marketplace. In contemporary years, short-video platforms have rapidly evolved with the expanding growth of modern video content and viewers' engagement. Short video platforms have been constantly breaking records for the number of videos uploaded and the length of time viewers watch the videos. The large and complex user behaviour data in short video content provides solutions to urgent problems for users (Guo, 2025). Short video content has significantly influenced the youth by providing high-quality content. For instance, advertisements that are represented by short video content are enhancing customers' purchase intention through valuable information and credibility. The rise of short video content has also transformed the habits of traditional consumption. Products promoted by live streaming and group buying activities in short videos enable consumers to buy products without leaving their homes. At the same time, these platforms are encouraging youth to create a channel and provide others with useful information and entertainment (Lin et al., 2022). In summary, short video platforms make users concerned about the world and with national pride.

Mediating Variable

- **The Digital Era**

  The digital era is a time frame where a transformation of processes occurs from an industrial context to an informational economy using computers or any other digital technology. The digital era is a period when there is widespread and easy access to information in an advanced and accessible form. The retrieval and transmission of information is mainly based on the internet. Information technology has grown rapidly, resulting in the creation of several cutting-edge tools that make people's everyday lives easier. In addition, these contemporary technologies make it easier to store and change data in electronic forms. Modern devices such as smartphones and tablets are important gadgets for the new generations (Lin, 2022). The digital era has introduced new challenges and considerations in the design of user-friendly digital interfaces and workspaces. The integration of digital technologies in the workplace has led to the need for organisations to prioritise human-centred design principles. The digital platforms are ensuring that the tools are tailored to the needs and abilities of human users. The digital era has brought changes in the workplace as organisations strive to create a flexible and technology-enabled environment that fosters creativity, productivity and employees' well-being (Lyytinen, 2022).

Dependent Variable

- **Communication Strategies of Professional Media Organisations**

  Professional media organisations used systematic and goal-oriented approaches to engage and influence their targeted population. These strategies involve platform selection and audience segmentation to fulfil organisational objectives such as brand positioning and revenue generation. The professional media organisations are responsible for the content which is represented to the audience

by short video platforms or any other digital platforms. In the new digital era, the communication strategies are becoming more data-driven and audience-centred, relying on algorithms and user feedback to optimise reach and engagement with the users. The professional media also represent their content with storytelling techniques and visual elements to increase audience participation and engagement (Hartley et al., 2023). The communication strategies improve in response to new technological advancements and changing behaviour of users within the media ecosystem. Communication strategies are becoming more essential and influential for entrepreneurial abilities to improve organisational success and sustainable development. The complexity of business and market situations in the expanding number of communication channels and the requirement to successfully channel the message to the intended audience are all contributing factors to the communication strategies of professional media. Moreover, the communication strategies and performance of the professional media organisations are interconnected and influential for developing organisational effectiveness. The professional media organisations performance decreases without communication strategies. Organisations engage in a variety of activities to achieve their goals (Schnurr, 2024). Overall, the professional media organisations employ strategies to maintain credibility and effectiveness in delivering content while navigating the complexities of the rapidly developing digital environments.

- **Relationship between short video platforms and communication strategies of professional media organisations in the mediating role of the digital era**
  The communication strategy of professional media organisations is influenced by short video platforms, taking into consideration the mediation provided by technological improvements and the modifications in user behaviour in the new digital era. Within a new technological context, data-driven distribution and participatory culture serve as a bridge, thereby transforming the way material is supplied to users. Various professional media outlets are transitioning their material from traditional and long-period content to short-period content. Additionally, the content is transformed into a format that is both visually interesting and interactive to facilitate the quick development of technologies and to increase audience participation (Al Hadeed et al., 2024). A greater number of real-time updates and data-induced decision-making approaches in the form of platform analytics are also encouraged because of the mediation service of the advanced technological era. Considering this, the advent of the digital era has made it simpler for platforms that host short videos to grow. The significance of new media in public relations campaigns cannot be overstated. Many media companies now employ new digital technologies for their public relations operations. This transformation indicates several variables that accelerate the usage of new digital media for public relations. Public engagement and input are very crucial to the production and dissemination of information (Luo et al., 2025). On the other hand, it also actively intensifies their impact, which ultimately results in a fundamental rearrangement of media communication techniques towards storytelling that is centred on the audience and customisation.

  Based on the discussion, researchers have developed a hypothesis to evaluate the important connection between short-video platforms and the communication strategies of professional media organisations in the mediated digital era.

- ***"H01: There is no significant relationship between short video platforms and the communication strategies of professional media organisations, considering the mediating role of the digital era."***
- ***"H1: There is a significant relationship between short video platforms and the communication strategies of professional media organisations, considering the mediating role of the digital era."***

Table 2: H_1 ANOVA Test

ANOVA					
Sum					
	Sum of Squares	**df**	**Mean Square**	**F**	**Sig.**
Between Groups	84,758.527	265	5682.769	1177.532	.000
Within Groups	925.810	512	4.826		
Total	85,684.337	777			

This research has produced significant results. With a distinct F-value of 1177.532 and a distinct p-value of 0.000, researchers can determine that the statistical significance is below the 0.05 alpha level. The findings emphasise that the null hypothesis was not accepted, and the alternative hypothesis, ***"H_1: There is a significant relationship between Short video platforms and the Communication Strategies of Professional Media Organisations, considering the mediating role of the Digital Era,"*** was accepted.

Findings and Discussion

The discussion of this study emphasised that short-video platforms had a crucial significance in the communication strategies of professional media organisations in the digital age. The statistical result demonstrated the strong validity and reliability. The KMO value was 0.961, which indicated a suitable sample size. Bartlett's test also ensured the significance of relationships between variables. The use of the ANOVA test further showed a statistically significant relationship between short video platforms and communication strategies of professional media organisations in the digital era. The null hypothesis was rejected because this ANOVA test evaluated a P-value below 0.05 and a distinct F-value of 1177.532. The F-value suggested that the transformation of communication strategies is highly pronounced.

These results demonstrated that professional media organisations had adapted their communication strategies to relevance with the advancement of short media content. The transformation from conventional media to short-form video content helps to make a relationship with the rapidly changing digital environment. Moreover, the results of this study suggested that platform-oriented content strategies had become central to modern media practices. In summary, the discussion ensured that short video platforms significantly reshaped the communication strategies of professional media organisations to communicate with the audience of the digital age.

The findings of the research study elaborated that professional media organisations employed communication strategies in the modern digital era had been dramatically altered because of the platforms designed for short-video platforms. The findings

suggested that there is a growing relevance of visually engaging and brief material in capturing the audience's attention. The content of short video platforms remains relevant in the highly competitive digital market. The professional media organisations were transitioning their material from longer-term forms to shorter forms and an interactive method. The transformation of content was brought about because of changing audience expectations, particularly among younger audiences, who required valuable and simple information that was easy to understand. In addition, the media organisations had increasingly changed their content quality, aligning with the platform dynamics. Consequently, these modifications made it possible for media firms to develop communication strategies that were appropriate for the rapidly evolving digital world. The organisations of media received considerable support from the short video platforms, which enabled them to communicate in real time and continuously update their content. The findings of the study emphasised that professional media companies began using storytelling techniques and multimedia components in their communication strategies to modify their approaches and increase the attention of audiences.

Conclusion

The current study explored the importance of short video platforms to create communication strategies in media organisations. The findings highlighted the way short video platforms influenced media companies to create and distribute high-value content. The statistical analysis significantly represented the relationship between the professional media groups communication strategies and short video platforms. This analysis indicated that the changes in short video platforms had already taken place with their interactive content. Media organisations prioritised audience engagement and real-time communication to adapt their practices. These changes represent a wider platform for media organisations with accessibility and user participation. Furthermore, the study concluded that the communication strategies of professional media have already been influenced by the interactive content of short video platforms. This research also underscored that real-time communication and audience participation become a priority for professional media organisations. Media firms improved their ability to communicate with audiences with features such as live streaming and algorithms for content distribution. This transformation in the media organisations highlighted the growing importance of audience-centric communication strategies. In summary, the short video platforms play an important role in reshaping the communication strategies of professional media. The incorporation of short video platforms will remain important for professional media organisations to sustain audience engagement and grow connections in the new development of the digital era.

The findings of the study may affect the professional media organisations theoretically and practically in the new digital era. Theoretically, the study had extended the way short-video platforms reshaped the traditional communication system. It had demonstrated Agenda-Setting Theory to evaluate the way audience engagement influenced the prioritisation of content. These changes had highlighted the communication strategies of professional media in a more data-driven environment. On a practical standpoint, this study may indicate significant knowledge to media organisations, adapting the communication strategies to remain competitive and audience-focused through the integration of short video platforms. The findings of the research suggested that the digital tools had become important for improving audience engagement and the effectiveness of communication strategies. In the future, the implications of the research may be beneficial for lawmakers and researchers in reshaping the frameworks of digital communication. In

conclusion, the study suggested that the adaptation of new technologies might improve audience engagement and organisational relevance in the new digital era.

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The Epic “Shahryar” And Karakalpak Folk Tales Similar Features of the Character System

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Abstract

Resume. The article analyses the similarities of the image system of epics and fairy tales. In particular, common aspects in the images of Karakalpak folk tales and "Shahryar" epic are studied. Several folklorists attempt to illustrate with examples the preservation of historical events from different periods within the epic's plot and the inclusion of the names of individuals who lived in the past. Several folklorists attempt to illustrate with examples the preservation of historical events from different periods within the epic's plot and the inclusion of the names of individuals who lived in the past. The life-related events depicted in the composition and plot of the epic seem to be overshadowed by mythical and fairy-tale elements. Therefore, we conclude that it is appropriate to classify the Karakalpak folk epic "Sharyar" in terms of genre within the group of "epics with mythological fairy tale plots," which reflect social and everyday issues.

Keywords: Epic, Fairy Tale, Motive, Plot, System of Images

Introduction

Although epics with fairy-tale-type plots mainly reflect social and everyday issues, their classification as works of a mythological fairy-tale type can be theoretically substantiated by the presence of ancient archaic motifs, such as the supernatural birth of heroes and their maturation with the support of divine forces, as well as by the depiction of mythological views and beliefs intertwined with realistic portrayals of daily life. These features can be clearly observed in the system of characters of epics with fairy-tale-type plots.

Review of Related Literature

It is difficult to determine precisely in which century or year the epic “Sharyar” originated and to establish its exact genesis. However, Karakalpak scholars such as Q. Ayimbetov, Q. Maksetov, and I. Sagitov associate the events of the epic “Sharyar” with ancient times and long historical periods. Professor Kh. Abdullaev, who studied the interrelations of Uzbek and Karakalpak folklore through epic traditions, concludes that the plot of this epic emerged “on the basis of everyday folk tales of Turkic peoples”. In general, the genesis of the epic dates back to very early periods, when it existed in oral form as myth and fairy-tale narratives. This is because mythological consciousness represents one of the earliest forms of human thinking, and as a product of such consciousness, the epic “Sharyar,” shaped in a mythological and fairy-tale form, is considered “a heritage of the Karakalpaks preserved from ancient times”. Literary scholars Q. Bayniyazov and T.

Bayniyazova, who likewise associate the origins of the epic with ancient periods, also support these views. Their distinctive contribution, compared to other scholars, lies in their efforts to demonstrate through examples that the plot of the epic preserves historical events from different periods and even includes the names of individuals who lived in the past.

Objectives

This study aims to analyze epics with fairy-tale-type plots, focusing on their mythological motifs such as supernatural births, divine intervention, and archaic beliefs. The objective is to show how these elements intertwine with realistic depictions of daily life, shaping the system of characters and justifying their classification as mythological fairy-tale narratives.

Methodology

This study employs a qualitative, descriptive approach, analyzing primary texts from Mahmud Kashgari's Divanu Luǵat-it-Turk, Karakalpak folklore, and epic narratives. Cognitive-discursive and comparative textual analyses were conducted to identify mythological and fairy-tale motifs, character systems, and historical-cultural continuity, ensuring contextual interpretation of archaic motifs within the narrative structure.

Findings and Discussion

In epics, special magical power is often embodied in the image of a bird. In this context, there are elements of archaic myth, such as belief in the magical power of words (for example, when Sharyar recites a spell to the bird Bulbilgoya, makes a mistake in the words, and is defeated). A noteworthy feature of the epic is that all living beings and even inanimate objects are endowed with speech and act like humans. For instance, the speaking of a horse, a bird, a mountain, a lake, a desert, the sky, and the earth, as well as clouds providing shade for humans, are connected with the mythological worldview of ancient people. This reflects their perception of both animate and inanimate objects as objects of cult. In the epic, the image of the bird Bulbilgoya is endowed with magical properties: it can move a city from one place to another, exercise power over both the underworld and the surface of the earth, kill a person with its song, and revive them. The image of Bulbilgoya enters in the middle of the plot and develops into an independent character, increasing the compositional complexity of the epic and serving an artistic function in resolving and concluding all events. After being defeated by the spell, the bird Bulbilgoya becomes the guardian of Sharyar's royal domain, protecting the city by singing in various melodies. The prominent place of the bird image within the epic's plot likely reflects the mythological concepts embedded in the thinking and worldview of people since ancient times. This is also confirmed by archaeological findings discovered in certain ancient fortresses. For example, even without referring to findings from other regions, scholars who conducted research at the Akshakhan-kala archaeological site, located in the territory of the "Azat" collective farm in the present-day Beruniy district of Karakalpakstan, write as follows: "…the defensive walls of the temple-palace turned out to be a gallery decorated with three rows of coloured images along their entire length. In the lower, first row of the gallery, images of ceremonial equestrians in four or five colors have been preserved. In the upper rows, portraits framed by double black lines are depicted. Among these portraits are noble figures wearing remarkable garments, with crowns adorned with bird images and necklaces resembling mythical creatures (dragons). The birds depicted on the crowns resemble the 'bird of fortune' known in the fairy tales

and legends of Eastern peoples, according to which ‘if the bird of fortune lands on someone’s head, that person becomes a king, and if it lands on the shoulder, he becomes a vizier.’ This idea seems to be confirmed by the inscription ‘king’ preserved beneath one of the portraits. Radiocarbon analyses conducted in laboratories in Oxford (United Kingdom), Sydney (Australia), and New Zealand have determined that the Akshakhan-kala portraits date back to the 2nd–1st centuries BCE”. In epics and fairy tales, the motif of selecting a ruler with the help of birds, regarded as a “bird of fortune,” is widely preserved. For example, in the epic “Edige,” Satemir Khan releases the bird of fortune, and it lands on Tokhtamysh’s head, upon which the ruler understands that fortune is with him. A similar episode is also found in the epic “Sharyar.” In the epic, Khizir, who appears in the form of a dervish, comes from the unseen and releases the bird Bulbilgoya. Even when the bird is released three times, the “bird of fortune” lands on Sharyar’s head each time. Thus, Sharyar ascends the throne of Suleiman. In this way, within the plot of the epic “Sharyar,” the image of the bird Bulbilgoya occupies a central place both in the initiation of events and in resolving the conflicts that arise among the main characters. This suggests that ancient people’s perception of birds and the depiction of bird imagery had already formed as early as the 2nd–1st centuries BCE. The portrayal of Bulbilgoya in the epic “Sharyar” as a miraculous and magical bird reflects the ancient worldview and attitudes of people toward birds. Throughout the content of the epic, imaginary events, strong fantastical elements, and mythological features characteristic of ancient times are depicted from beginning to end. This view is supported by the opinion of Professor I. Sagitov, who states: “Whereas in epics such as ‘Alpamis’ and ‘Qiriq qiz’ heroes defeat their enemies through their own bravery and heroic strength, in ‘Sharyar’ the heroes overcome their enemies through the power of spells. In this epic, mythological (fantastical) elements such as dragons, giants, fairies, Bulbilgoya, and the ring of Suleiman occupy a significant place”. Because of our research, we have observed that in the poetic structure of the epic “Sharyar,” mythological and fairy-tale motifs predominate over other genre-forming features. As noted above, in the course of achieving their goals, the heroes of the epic experience imaginary and fantastical events that go beyond human logic and rational understanding.

Conclusion

In general, the events related to everyday life that are depicted in the composition and plot of the epic seem to be overshadowed by mythological and fairy-tale elements. Therefore, we conclude that the Karakalpak folk epic “Sharyar” can appropriately be classified, in terms of genre, among “mythological fairy-tale-type epics” that reflect social and everyday issues. In terms of both content and form, epics with plots similar to “Sharyar” have long been referred to in Uzbek, Kazakh, and Tatar folklore studies by terms such as “fairy-tale-type epics” (G.M. Egamberdieva) and “fairy-tale epics” (A. Konyratbayev), which are already well established in scholarly practice.

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Indication of Somatic Units as Reference Words in Phraseological Units

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Abstract
In linguistics, the terms of body parts are related to their names in Greek (soma - body), and in scientific research, this term is defined by the concept of somatic associations, somatism - terms of human body parts. There are three terms of body parts in all languages, both individually and in phraseological units. Somatisms are the dominant word in phraseologisms (supporting word, support word) as they are distinguished by the wide possibility of forming new words, metaphors. The names of somatisms are not common body part terms in common language knowledge, they are widely known in the concept of human body parts. As the terms of animal body parts have a common character with the terms of human body parts, in linguistics the terms of fauna and the body parts of animals are called animalistic units, and the phraseologisms that come with the terms of body parts of animals are phraseological idioms. The terms of body parts do not only belong to humans, but they are also considered common units belonging to the animal world. Sometimes there is a similarity between the terms of animal body parts and human parts, that is, they are emphasized in a common form, written, and expressed in a common sense, but in almost the majority of cases, the physiological characteristics of the animal body depending on its properties, creation, adaptation to nature (swimming, flying, crawling on the ground, etc.), is also called with completely different lexemes, dissimilar units.

Keywords: Body Parts, Linguocultureme, Linguistics, Somatisms, Phraseologism

Introduction

Among the Turkic languages, the Karakalpak language has its own sound structure, grammatical structure, lexical structure, and phraseological system. Phraseological word formations in the vernacular have been formed and completed in the long history of the people, and together with them, they have a cumulative effect. They make up a separate group of vocabulary, change and maintain the structure of imagery and influence, and are distinguished by the combination of unique signs of the language of the Karakalpak nation.

In the structure of phraseology, a number of words are used as reference words. For example, we can see the presence of colour, number, zoonyms, size, phytonyms in their structure, we will learn color, sand, zoonyms, size, phytonyms, names of dishes, names of things and human body parts. This, of course, indicates the constant change of these units when they are used in the structure of phraseology, and also shows that they are

different from each other. This means, it confirms the existence of certain dimensions in the display of the similarity between phraseologisms.

So, in the structure of phraseologisms, there are somatic phraseologisms, which are related to the terms of human organs, and they are of great importance from the theoretical and practical point of view.

Review of Related Literature

With the development of the anthropocentrism direction in the present period, there is a different approach to the search for phraseologisms with somatic associations. Language elements are interrelated. This relationship creates a single connected system. One of these systems is the phraseological system, where linguistic legalities are based on somatic phraseologisms, linguistic scientific evaluation of its hitherto undiscovered aspects, linguistic aspects of the science of linguo-cultural aspects, means filling in the gaps, finding answers and solutions to problematic questions.

Language is a means of conveying ideas and thoughts within themselves, as well as culture. Somatic phraseology plays a significant role in expressing the national consciousness of the people. Body parts are among the oldest lexical categories in any language. For example, the memories of the early period (V-VI centuries) are related to human organs in the written memories of Orkhon-Enisei: aǵız-awız, (mouth) yúrek-júrek, (heart), kókuz-kóksi (chest), adaq-ayaq (leg) (Mog.30), arqa (back) (Ton.5), besh-bes (five) (kt4), boy-boy, dene (height, building) (ton 4), yanaq-jaq (jaw) ((Mog.12), kóńil (mood) (ktm,12), kóz (eye) (Mog.2), qulǵaq-qulaq (ear) (Mog.12), súńúk-súyek (bone) (KT 24), sach (hair) (Mog.1), ed-et (flesh) (Mog.29), tiz-dize (knee) (KT.26), til-til (tongue) (Ton.56), qan (blood) (Ton, 52), qash-qas (eyebrow) (E, 26) [1. 31] and so on. In Makhmud Kashkhariy's work "Devanu lugatat turk" somatic units as azäq-ayaq leg (p-96), ashuq-tobıq (97-b.), ashuk-ankle (p. 97), ozak-a vein in the inner part of the waist (p. 101.), elig-hand, right elig-right hand (p. 102), ïrin-lip, (p. 106), ağrug-ağrug sönüki-the first of the vertebral bones (p. 123), uzluq-thick part of wrist bone (p. 124), ÿmgÿk (soft place on children's heads) (p. 134) [2. 498], öpkä-lung (p. 148), ĕńäk-cheek on two sides, two sides of the mouth (p. 154) and many other somatic units are given. Asan Bakhti compares the Turkic language with the ancient Sumerian and Scythian languages and shows the similarity of several words as follows.

In Sumerian: zag- jaw, hip, in Turkic: zaǵ, yaq, djaq jaw, hip; in Sumerian: emek-tongue, in Turkic emek-emuk - tongue; shi (zi) life; soul, in Turkic language shi (chi, dji, zi) is a suffix that gives the meaning of a person (typical to all Turkic languages) (here shı/-shi is noun forming affix denoting the meaning of a man: balıq(fish) – balıqshı(fisher), suw(water) – suwshı(waterman) (S. Shynnazarova); in Sumerian language, geshtuk - ear, in Turkic language, eshtuk - audible noise [3. 55].

Therefore, such associations prove that the terms of the body parts used in the Turkic language belong to the oldest lexical covering by their origin. So, geshtek in the Karakalpak language is a place where young people hang out, the original meaning of which was transferred from the old Sumerian language to Turkic language. It is directly related to the original form of geshtuk - to hear (ear) - like geshtek, and we believe that the way of hearing the fun in geshtek through the ears is directly related to the original form from the etymological point of view.

So, taking into account the belonging of the terms of body parts into the oldest language, it can be recognized that somaticity was in continuous use throughout the formation of the language.

In linguistics, the terms of body parts are related to their names in Greek (soma - body), and in scientific research, this term is defined by the concept of somatic associations, somatism - terms of human body parts. There are three terms of body parts in all languages, both individually and in phraseological units. Somatisms are the dominant word in phraseologisms (supporting word, support word) as they are distinguished by the wide possibility of forming new words, metaphors.

So, the ability of somatisms to be accelerated in the language depends on the function of these language units. The reason is that when a child first steps into the conscious human world, he begins to recognize and learn himself with the help of body parts. Due to the fact that the body evaluates these somatic units, the name of the body part, the external natural influence (cold, heat, humidity, etc.) in comparison with the surrounding world through phraseological recognition, these terms begin to enter into speech not only in denotative sema, but also in connotative sema.

When a baby comes into the world, he recognizes the things around him as water, bread, parents, and begins to recognize his physiological body structure by its own name, such as hand, head, mouth, eyes. And, in phraseologisms, body terms can create imagery and differ from the semantic aspect.

A.Bolganbaev calls the phraseologisms with the terms of body parts in the Kazakh language "phraseologisms related to anatomical names" and indicates that 4200 phraseologisms are included in the multi-volume explanatory dictionary of the Kazakh language. The scientist divides the phraseologisms with terms of body parts into five groups: head limbs, hand limbs, body - external organs, internal organs, foot limbs [. 4. 105-132].

Objectives

During their conscious life, with the development of human history, the human was the first to be aware of the things around him, to recognize himself and his own body in his concepts. The behavior and movement changes in people close to a person are compared to their body and body parts, and they end up with a marked conclusion. This led to the formation of associations involving parts of the body in the language, first in the form of words, in the phrase, and then in the set phrase.

For that reason, the somatic associations, allusions, paraphrases, and metaphors that have been established in our language have been deeply spread and absorbed into our language. For example, in the origin of set expressions such as mushtai bala (young (by appearance and age) child), et penen tırnaq (flesh and nails), kóz benen qastay jaqın (as close as eyes and eyebrows (kinship, closeness), as a clapping (a young child), we can understand such notions as comparison, simile, measure, proximity and distance of some concepts. So, in the stages of formation, the human being engaged in work, expressed their own reactions to each other's thoughts, which in turn caused the formation of linguistic associations. Consequently, they feel the need to convey some idea to each other in a figurative and effective way. This state can be considered as having a certain importance in the formation of somatic phraseologisms and in the completion of the line.

Methodology

Somatisms in the Karakalpak language perform the function of a supporting lexeme in the formation of metaphors, especially in polysemous words and metaphors.

Somatic phraseologism is universal for all languages. For example, in Russian linguistics, the lexeme of body parts is explained in the dictionary "for the human body and its appearance", (human body, corpus - S. Shınnazarova) [. 5. 134], "Man and animals, their physical form, parts of the organism, the beginning from the head and end of the part"[. 6. 793].

Also, in the vocabulary of the Russian language, the names of human body parts are given by 74 lexemes, of which 59 names of body parts are denoted by somatic components and reference words in the structure of phraseologisms. In the Karakalpak language, somatisms (terms of body parts) are also productive.

Comparing the somatisms that are used alone and the phraseologisms that are not used as part of phraseologisms in the explanatory dictionary of the Karakalpak language, which consists of four parts, then in this dictionary, we find out that a total of 195 somatisms are used in all four parts, of which 150 are found in the structure of phraseologisms, and 45 are not used in this structure and those are used in their main nominative sema.

The terms of body parts do not only belong to humans, but they are also considered common units belonging to the animal world. Sometimes there is a similarity between the terms of animal body parts and human parts, that is, they are emphasized in a common form, written, and expressed in a common sense, but in almost the majority of cases, the physiological characteristics of the animal body depending on its properties, creation, adaptation to nature (swimming, flying, crawling on the ground, etc.), is also called with completely different lexemes, dissimilar units.

Analysis

For example: if the terms of body parts such as head, eyes, legs, blood, bone, back, vein, ear, and tail are common to both humans and animals, then there are cattle body parts used based on their physiological structure: hawke(hooves), tuyaq (hoof), ultabar(abomasum), muyiz (horn), qılshıqli terisi(leather with wool), shuw(afterbirth) (friend, gift), long tails, in camels: workesh (hump) in horses: zhal (mane), in birds, for example, in chickens: zhemsek(goiter), wing, feather; in fish: kalash (fin), sagaq(gills), uwıldırıgi (caviar); in snakes: kebi (skin), uwlı tisi (fangs) etc. have their own body parts different from human body parts.

Findings and Discussion

Therefore, the names of somatisms are not common body part terms in common language knowledge, they are widely known in the concept of human body parts. As the terms of animal body parts have a common character with the terms of human body parts, in linguistics the terms of fauna and the body parts of animals are called animalistic units, and the phraseologisms that come with the terms of body parts of animals are "zoosemism", "zoophraseologism", "phraseological idioms", "faunal terms", "zooonymic-animal phraseologisms", "phraseological zoonyms", and phraseology related to animal terms are given by various terms" [7. 11]- asT. J. Miqtibaeva shows.

So, in linguistics, somatic phraseologisms are s phraseologisms in which the names of human body parts participate as supporting words.

All somatic units cannot take place in the structure of phraseologisms. Somatisms have phonetic variants, are subject to metaphorization, and have a polysemic nature. The reason is that the names and concepts of the human organ have not a single meaning, but a number of them are productive with figurative meaning. For example: somatisms like mouth, eyes, hand, head, nose, etc. do not indicate only human body parts, but they can be denoted by transition from the the main meaning to the figurative meaning.

Conclusion

In conclusion, this characteristic of somatisms proves that they have a wide range of possibilities and opportunities to participate logically with other language units. The use of terms of human body parts as a pillar occupies a special place in the phraseological system of the Karakalpak language.

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Stylistic Functions of Phraseological Units on the Example of I. Yusupov's Works

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Abstract

This article analyses the stylistic functions of idioms in the works of Ibrahim Yusupov. The functional and stylistic features of colloquial phrases in the Karakalpak language, their imagery, and emotional-expressive possibilities were studied using specific examples. It has been established that phrases in the poet's works are used in connection with artistic devices such as metaphor, metonymy, synecdoche, hyperbole, and litotes. The stylistic function of transformed variants and simple elements of proverbs and sayings was also demonstrated. As a result of the research, the special aesthetic and communicative role of phrases in a literary text has been proven.

Keywords: Colloquial Idioms, Functional Style, Idiom, Literary Style, Style

Introduction

In linguistics, the science of stylistics is of particular importance. This field is essential not only for linguistics but also for literary studies. Stylistics, derived from the Greek word «style, » means a sharp, pointed stick for writing.

Review of Related Literature

In Karakalpak linguistics, the study of style is evident in the works of Prof. E. Berdimuratov. In his works, the scholar provided comprehensive information on stylistics, including the functional stylistic features of the Karakalpak language, its stages of development, and their role in enriching vocabulary.

In this regard, Prof. E. Berdimuratov emphasized that style appears as a system of linguistic tools formed with functional adaptation to life spheres, various forms of communication through language, and specific situations in terms of lexical-semantic, grammatical, etc. - in the course of the historical development of language. Indeed, therefore, in our article, we intend to discuss the use of idioms in various stylistic functions in the works of I. Yusupov. Phrasemes are used quite freely, similar to broader and jargon words.

Objectives

The objective of this study is to explore the role of stylistics as a significant branch of linguistics that also holds deep relevance for literary studies. Derived from the Greek

word meaning “style” or “a sharp, pointed stick for writing,” stylistics focuses on the relationship between linguistic form and expressive meaning.

This research seeks to analyze how stylistics functions as a bridge between language and literature, examining the ways in which stylistic choices shape interpretation, cultural resonance, and artistic expression. By highlighting its dual importance in both linguistic science and literary analysis, the study aims to underscore the value of stylistics as a tool for understanding the interplay of language, culture, and creativity.

Methodology

Several scientific research methods were used in this article. First, based on the descriptive method, the stylistic features of phrases in the Karakalpak language were analysed and explained through examples. Through the method of contextual analysis, the use of idioms in the works of Ibrahim Yusupov was studied within the framework of a specific text, and their emotional-expressive function was revealed.

Based on the method of lexico-semantic analysis, the direct and figurative meanings of phrases were determined, as well as their connection with such artistic devices as metaphor, metonymy, synecdoche, hyperbole, and litotes. Through the comparative method, the stylistic features of spoken language phrases and literary phrases were compared, and the abbreviated versions of some proverbs and sayings were analysed by comparing them with their original forms.

Furthermore, the functional-stylistic analysis method served to determine the communicative and aesthetic functions of idioms in language.

Analysis

In our language, words perform a number of functional functions. Lexical and grammatical features, used in both literal and figurative meanings, based on artistic devices, contribute to the development of vocabulary. This phenomenon is also characteristic of phraseological units, where phrases perform a number of functional functions. They are more commonly found in literary works, especially in folk oral traditions.

According to scholars, fixed phrases characteristic of speech style are distinguished by their imagery, expressiveness, and comprehensibility [2.91]. Indeed, some of them arose as a result of the figurative, metaphorical use of free word combinations in the spoken language of the people: to wave one's hand, to bow one's neck, to look at one's hand, to know the essence of the matter, etc. Phrases in spoken language differ significantly in literary language. We can observe the skilful use of such colloquial phrases in the works of the poet I. Yusupov.

In his poem “The Inscription at the Head of the Slanderer,” (“Ǵıybatkeshtiń bas ushındaǵı jazıw “) the poet writes: “If this 'circular petition'(“domalaq xat”) is written, fear it // Many have been struck down by its slander, the deceased lying in neighbouring graves // after this, they were frightened and resurrected.” The “round petition” in this example refers to a petition submitted to higher authorities without an author being indicated. The idiom “ruined” means “unjustly dismissed.” For example: Like a lost traveller in the forest // you are putting us in a mess (Loneliness); When did a person ever fear this

calamity? // Like biting the finger of regret (If possible, live without being open); Arguing now, you are lost // A feast seen with many, my friend // Getting fat in the black water // you do not live happily without worry (Poet and Heart). The phrases in these examples, such as “to cause trouble,” “to torment,” “to inflict suffering,” “to bite one's finger,” “to regret the past,” and “to grow fat in black water,” convey the meanings of living carelessly and being indifferent.

In addition, colloquial phrases include proverbs and sayings used in our language. Because a certain group of them consists of abbreviated, modified versions. This situation can be observed in the poet's works, where some proverbs and sayings are omitted. For example: Those who waded through blood without taking off their boots for the people // those who drank water from a horse with a mouth (Poem “Nightingale's Nest”) (“Búlbúl uyası”) in this example, the proverb “When trouble befalls the people, they cross water with their boots.” “When the going gets tough, the tough get going.”

Another characteristic feature of colloquial phrases is their use in literary works, specifically in literary style. Naturally, the main characteristic of phrases is their imagery. They add an additional emotional-expressive meaning to the sentence.

Findings and Discussion

Now, we will conduct a comparative analysis of the imagery of these colloquial phrases and the presence of several tropes. For example, it can also be figurative in a metaphorical sense: «When you speak, even your words won't be bad if they're salty» (This place will still be great); Zarman arpa ishinde bir túp biydayǵa // Bir qızalaq kóriw ármanımız bar (“Men at the maternity hospital”) (“Erkekler roddomda”)

Phrasemes are also used in a metonymic sense. The phrase «blue paper» is a metonymy formed as a result of internal similarity in the meaning of «dollar.» For example: Where is this blue paper rustling?

In a literary work, the poet uses synecdoche to draw the reader's attention to a subject or phenomenon that depicts certain situations. For example: The nose struck by youthful desire // Will have at least a batman of wind (of the high mountains where many clouds have fallen overnight); you forced your own grief // you never shared your sorrow with a living soul (“The actress's fortune”) (“Aktrisanıń ıǵbalı”)

Dialogic phrases are phrases that characters use in their conversations. For example: Don't hesitate, Pirim biy // Offending the louse, Let's not throw the coat into the fire // Don't hesitate, Pirim biy - to the Khan, the wisdom of forty people // It won't heal by itself, my lady // The lake water will smell, that's how it is When the fish rots from the head // It tore my chest away // I have a regret as big as a horse's head // A man's food will be on the road // A wolf's food will be in the steppe // Don't be a sultan in a foreign land // Be a shepherd in your land. In these examples, the phraseologisms “Resenting a louse, throwing a coat into the fire,” “A Khan has the wisdom of forty people,” “A fish rots from its head,” “Separation against the enemy,” “A man's food is the road, a wolf's food is at home,” and “Better to be a foot in your own land than a sultan in another land” are used by the poet in his opera “Ajiniyaz” in the language of the characters depending on a specific situation, thereby enhancing their emotional and expressive impact.

Hyperbole is an artistic device that exaggerates and intensifies an object or phenomenon. Hyperbolic phraseologisms intensify and sharpen the thought. For example: My brave Karakalpak, His heart is like a wide field (“Don't break your nobility”) (“Begligińdi buzba sen”); Mount Elbrus touched the sky // Beautiful white-chested blue clouds kissed (“Longing”) (“Saǵınıw”) Your four hooves on my white chest // You say you'll hit me, my beloved (“Nightingale's nest”) (“Búlbúl uyası” This example is based on Gulparchin's line to Bayshubar from the epic poem “Alpamıs”: “May your four hooves be pressed to my white chest.” The expression “a horse's four hooves pressed against a person's chest” is an example of hyperbolic depiction, used to convey the meaning of “if you win this race, I will endure any hardship.”

Phraseologisms express the meaning of an object or phenomenon in a diminutive way. For example: Through two cracks like a needle's eye // As if a deep, mysterious blue light boils down // There's no need to prick a needle now // Those who couldn't fit stood at the club entrance // The cream hasn't left their mouth yet, You're just a chick (The actress's fortune) (“Aktrisanıń ıǵbalı”)

The phrases in the given examples with the meanings “like a needle's eye” - very small, “needle pierced” - dense, “white in the mouth” - very young are skillfully used to sharpen the thought.

In Russian linguistics, the term “prostorechie” is understood not as literary, but as a lexico-phraseological layer (dialectisms, words used in the language of a certain social stratum, jargon) [3.402]. The dictionary defines colloquial speech as follows: A type of speech characterized by crude, low-level characteristics, where words, grammatical forms, and constructions that deviate from literary language norms are widely used [4.63].

We also agree with this view, because colloquial phrases can naturally include more colloquial jargon phrases, and this can be seen in colloquial phrases. Therefore, we studied the phrases used in the poet's works by stylistically categorizing them into spoken language phrases. For example: The more you become, the more you want to be // The more you gather, the more you want to gather // In the end, you will suffer // Your chest will return from your knees (Mámálek oy). In this example, the simple phrase “to regret” means “if you regret it, you will regret it.” They all weep, covering their faces, with fear, grief, and curses in their eyes (“The Ossuaries' Song”) (“Ossuarlar qosıǵı”).In this example, the simple phrase *betin asıp jılaw* is rendered in a crude, sharp sense

Many fixed phrases that were previously colloquial phrases are now becoming functionally unlimited. For example, losing the end of a rope, losing the end of a flower, losing the end of a rope, losing the end of a rope, losing the end of a rope with all one's might, etc. The main criterion for identifying functionally and stylistically indistinguishable phrases is semantic quantity. Phrases of this type, expressing thematically general concepts, are used in colloquial speech, literary and journalistic styles, and in some cases, in scientific style.

Conclusion

Thus, the functional changes in phrases in the Karakalpak language, as well as their differences from literary and colloquial phrases, require their study by dividing them into separate groups. Speech phrases in the Karakalpak language exhibit a certain degree of functional-stylistic variation. Therefore, we deemed it appropriate to study them by

dividing them into spoken phrases. They constitute the majority of phrases in the literary language and are stylistically neutral, possessing the ability to be used interstitially. As a result of their frequent use, colloquial phrases later formed the majority of phrases in the literary language.

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Environmental Aspects of Fertilizer Application in Modern Agriculture in the Aral Sea Region

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Abstract
Education in The article examines the ecological aspects of fertilizer application in modern agriculture in the Aral Sea region. The main reasons for the pollution of the environment by fertilizers should be considered not the fertilizers themselves, but the imperfection of the organizational forms, as well as the technology of storage, application of fertilizers, violation of the agronomic technology of their application in the crop rotation and for individual crops. Quantitative assessments of the consequences of harmful substances entering the soil on the day of scientific analysis should be based on a strictly established "dose-effect" relationship.

Keywords: Ecosystems, Fertilizers, Irrigated Lands, Soils, Spectral Analysis

Introduction

Due to the constant increase in the anthropogenic pressure on the biosphere and the intensification of the impact on the soil caused by the implementation of agricultural works and the activities of industrial enterprises, the question of assessing the ecological state of this extremely important and complex natural object is becoming increasingly urgent. An important object of environmental regulation is the ecological state of the surrounding natural environment, which is understood as a complex of properties that determine its ability to ensure the stable functioning of ecological systems, the natural environment and the preservation of the physical and geographical basis of the territory.

Most environmental problems cannot be solved without considering soil as an indispensable and irreplaceable component of the biosphere at all its structural levels. A necessary condition for ensuring a high level of economic development and a favourable medical and demographic situation in an administrative region is maintaining the balance between the use of natural resources and the state of the environment within the limits of environmental norms.

Review of Related Literature

The literature on soil science and ecological sustainability highlights the multifaceted role of soils in maintaining ecosystem stability and supporting agricultural productivity. Foundational works such as Kovda (1985) on the biogeochemistry of soil cover and Volvolsky & Nikitin (1990) on soil functions in the biosphere emphasize the central role of soils in regulating biogeochemical cycles and sustaining biodiversity. Karpachevsky (2005) further advanced the field through ecological soil science, underscoring the interconnection between soil health and environmental resilience.

Several studies address the challenges of soil degradation and salinization in Central Asia. Shirokova & Chernishev (1999) developed express methods for determining soil and water salinity in Uzbekistan, while Tolepova (2005) examined salt accumulation in the lower reaches of the Amu Darya. More recent work by Tolepova & Djumanazarova (2022) outlined principles for regulating the water-salt regime of irrigated soils in Karakalpakstan, highlighting practical approaches to drainage and soil management. These studies align with Chembarisov & Khodjamuratova (2008), who analysed collector-drainage waters in Karakalpakstan, pointing to the hydrological dimensions of soil salinity.

Ecological monitoring and assessment frameworks have also been developed to evaluate soil quality. Glazunov & Gendugov (2013) provided an ecological assessment of soils and lands, while Motuzov & Bezuglov (2007) emphasized soil ecological monitoring as a tool for sustainable management. Nabieva (2016) contributed insights into changes in soil properties and microbiological activity under pasture plants, linking soil health to vegetation dynamics.

Taken together, these studies reveal dual trajectory theoretical explorations of soil functions in the biosphere and applied research addressing salinization, water-salt regimes, and ecological monitoring in Uzbekistan and the Aral Sea basin. This convergence underscores the importance of integrating soil ecology, salinity management, and ecological monitoring to ensure sustainable land use and biodiversity conservation in vulnerable regions.

Objectives

Soil as a monitoring object, being a complex multiphase and multi-component system, has a number of specific natural functions and features. First, it is rich in fertility, the preservation, maintenance and multiplication of which is a priority task of man. Secondly, the soil, due to its peculiarities of structure and composition, performs a protective function, retaining pollutants and preventing them from entering adjacent environments and plant, animal, and human organisms. The other side of this is that by binding the pollutants, the soil itself can become their storage and a source of long-term pollution of groundwater and living organisms' tissues. The diversity of soil cover functions ensures the high significance of soil state indicators for assessing the state of the environment as a whole, based on their integrity, relatively low dynamism, and significant in formativeness .

It is known that increasing land productivity depends mainly on the land's reclamation state, which is expressed in the depth of groundwater occurrence, their mineralization level, soil salinity level, and crop yields.

The main reasons for the pollution of the environment by fertilizers should be considered not the fertilizers themselves, but the imperfection of organizational forms, as well as storage technologies, the application of fertilizers, the violation of the agronomic technology of their application in rotation and for individual crops (including non-proportionate or unbalanced), the imperfection of the fertilizers themselves, their chemical, physical and mechanical properties.

The irrigated area of Karakalpakstan is 504.8 thousand hectares; the Karakalpak Hydrogeological and Land Reclamation Expedition (Fig. 1) constantly monitor almost the entire area.

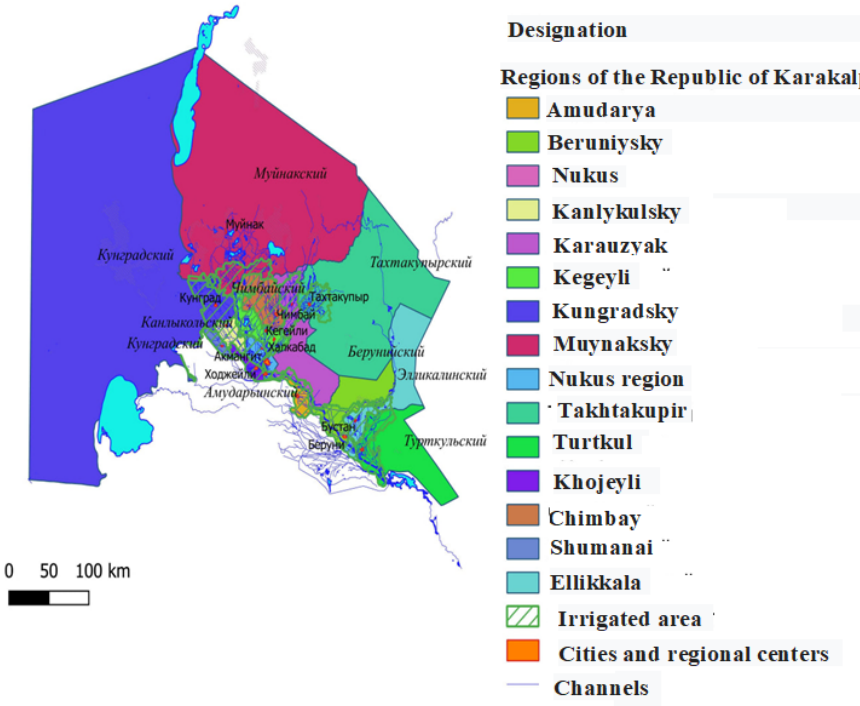
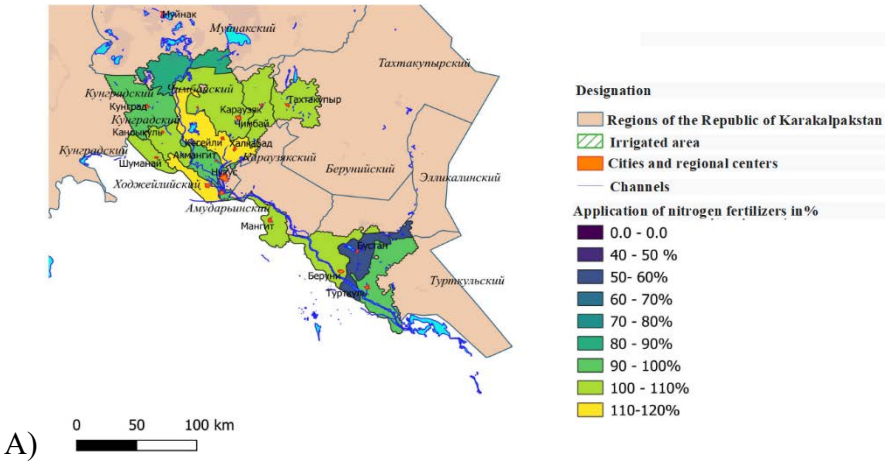


Figure 1. Map - diagram of the irrigated area of land in the Republic of Karakalpakstan

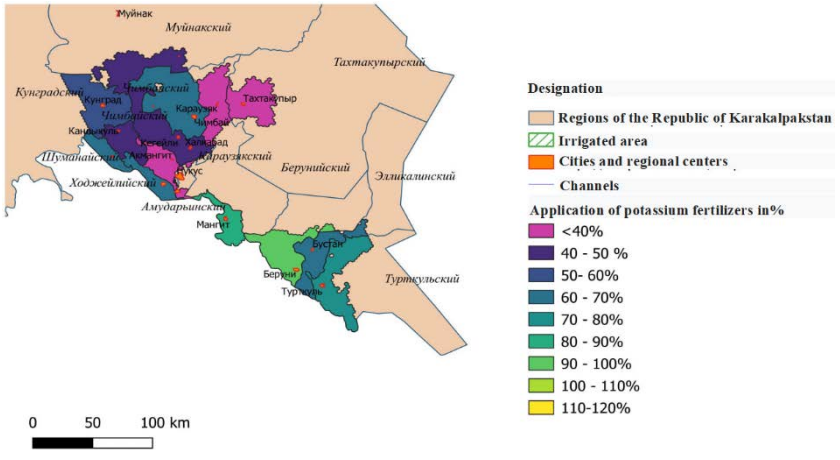
Most mineral fertilizers are characterized by physiological acidity, therefore their use in excess leads to the development of soil acidification processes. In addition, this leads to a decrease in the sum of absorbed bases, an intensification of mineralization processes, a violation of the ratio of mobile forms of macro-and microelements in the soil and the elemental composition of plants. Thus, the application of high doses of nitrogen fertilizers leads to a disruption in the exchange and supply of sulphur to plants, which negatively affects the quality of the harvest. As a result of soil acidity, phosphates are fixed in the soil, which deteriorates the phosphorus nutrition of plants; in addition, aluminium ions are released, which are toxic to soil biota and plants.

The classification of mineral fertilizers can be represented by three main chemical elements: nitrogen, potassium, and phosphorus. These three elements are leading in the nutrition of plants and have a significant impact on their growth and development. Nitrogen, phosphorus, and potassium are considered the foundation for the harmonious development of the plant world. Their absence or lack leads to weak growth and further

death of plants. The positive aspects of using mineral fertilizers are that they are quite cheap, and with minimal costs, they can significantly increase crop yields (Fig. 2).



A)



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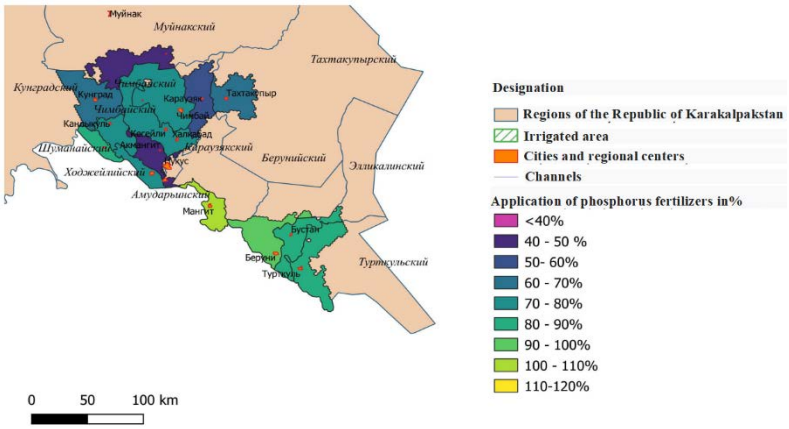


C)

Figure 2. Map - scheme for applying mineral fertilizers to irrigated lands of the Republic of Karakalpakstan (A - nitrogen, B - potassium, C - phosphorus fertilizers)

The unfavourable effects of fertilizers on the natural environment, the particular components of agrotsenoses can be very different (contamination of soils, surface and groundwater, soil compaction; disruption of nutrient cycle and balance, deterioration of agrochemical properties and soil fertility; deterioration of phytosanitary condition of crops and development of diseases of plants, reduction of productivity of agricultural crops and quality of the resulting products, etc.).

The deterioration of the reclamation state of irrigated lands is caused by an increase in groundwater levels and mineralization, irrational use of land and water resources, poor technical condition of the drainage network, and inefficient operation of irrigation systems. At the same time, soil salinization occurs in higher watershed areas. Overall, relatively low loam and clays develop desert-sandy soils. With increased drying, the solonchaks undergo semi-automorphic stages of residual solonchaks, followed by surface desalination.

The principles of environmental risk management include the normalization of harmful impacts and their reduction to a safe level, as well as the resolution of regional tasks for regulating and preventing the technological load and assessing the effectiveness of economic and administrative measures taken. Leading risk management mechanisms include determining the permissible content of pollutants in soil and other natural environments.

The ecosystem approach is based on the hypothesis that only the state of ecosystems can be normal if they maintain their integrity and the closed nature of the substance cycle. The approach operates on the principle of a weak link, when the maximum load should be recognized as such that there is no significant violation of the most vulnerable component of the ecosystem. As indicators of ecosystem stability, it is proposed to use: soil humus balance, indicators of preservation of the vertical and horizontal structure of the phytocenosis, indicators of soil productivity and fertility (closed biogeochemical cycles of the main elements of biogens, completeness of trophic chains, presence/removal of dominant species from the community structure, assimilation capacity, that is, the amount of pollutant that the system can perceive without disruption of its functioning).

Methodology

The research was conducted in the arid zone of the Republic of Karakalpakstan, occupied by irrigated soils, in the farms of the Shumanay, Kanlikul, Chimbay, and Taxtakupyr districts located in the central part of the South Aral Sea region. The climate of the Aral Sea region is sharply continental with dry and hot summers. To determine the degree of salinity, soil samples were taken from each site in the upper 0-20 cm layer by the envelope method. The content of chemical elements in soils in various regions of the Republic of Karakalpakstan was studied by spectral analysis in the laboratory of the Karakalpak Branch of the Academy of Sciences of the Republic of Uzbekistan.

Analysis

Excessive application of nitrogen fertilizers can lead to the accumulation of nitrates in the soil and agricultural products. Numerous toxic elements (Ni, Cu, Pb, Cr, Zn, fluorine toxic compounds) are found in the soil with phosphorus fertilizers (Fig. 3). Natural phosphates contain radioactive elements such as uranium, radium, and strontium. Increased phosphorus content in natural waters due to transport losses (34%), surface runoff and leaching from soils (21%), "discharge" of phosphorus from the agricultural cycle (almost

complete absence of organic matter utilization in the communal sector and reduction to 50% of organic matter utilization in animal husbandry, 45% of all receipts) leads to the eutrophiesis of water objects: water flowering, deterioration of conditions for direct water consumption.

Due to the increasing scale of soil contamination and, consequently, contamination of plant and animal products with heavy metals (cadmium, lead, mercury, copper, zinc, etc.), research on studying the conditions of their entry into the edible parts of plants and determining the actual extent of accumulation of these elements is of great importance. Cultivated plants are a source of a significant number of biophilic elements, as well as elements that are hygienically hazardous for humans and animals. In this regard, information is needed on the extent of accumulation of chemical elements, especially heavy metals, in products depending on growing conditions, plant species, and varieties.

As facts accumulate about the negative and positive effects of chemical elements on plants, animals and humans, the question of the need for more thoughtful selection of nutrients with the desired direction of their influence on the biological and nutritional value of plant products becomes increasingly urgent. Since plants are at the beginning of the biogeochemical food chain, controlling the content of chemical elements in plant products, the possibility of their regulation, and studying the dependence of human, animal, and plant health on biogeochemical environmental conditions are the most important tasks of ecological agro chemistry today and in the future.

Quantitative assessments of the consequences of the entry of harmful substances into the soil on the day of scientific analysis should be based on a strictly established "dose-effect" relationship. However, in modern toxicology and environmental protection activities, as a rule, an alternative nature of assessing such dependence is accepted, which presupposes the presence or absence of a toxic effect at a given level of exposure.

Findings and Discussion

The methodology for analyzing the risk of soil pollution is an integral part of environmental management, as it is ultimately intended for decision-makers and serves as a tool that allows for quantitative assessments of the probability of risk, providing a scientific basis for decision-making (Fig. 3). When assessing the safe level of chemical substances entering the soil, it is based on the idea that it is not permissible to exceed the limit of the ecological adaptation of the soil and the adaptation of the most sensitive population groups of organisms under the isolation, complex and combined action of harmful substances.

In this case, elements that perform important functions in photosynthetic organisms and soil-vegetative associations are of particular importance. Spectral analysis of the presence of various microelements in the soil showed that only 29 chemical elements were found in the studied areas. It should also be noted that in all four districts of Karakalpakstan, the maximum amount falls on the content of Si, which ranges from 35.7 to 44.5%.

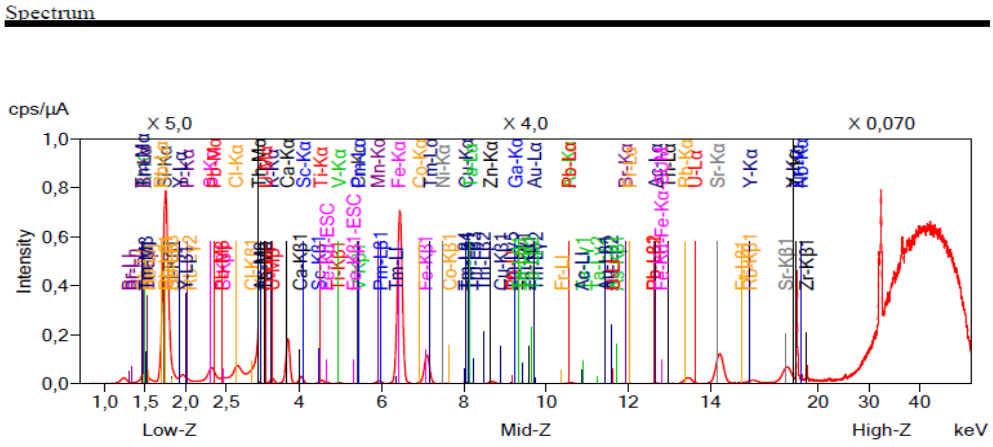
Si is one of the least studied microelements in plants and the soil-plant system. The high prevalence of silicon (200-350 g/kg in clayey and 450-480 g/kg in sandy soils) provides this element with a significant role in the processes of soil formation and soil fertility formation.

Table 1. Analysis results for the presence of various chemical elements in the soils of the studied areas of the Republic of Karakalpakstan (2023)

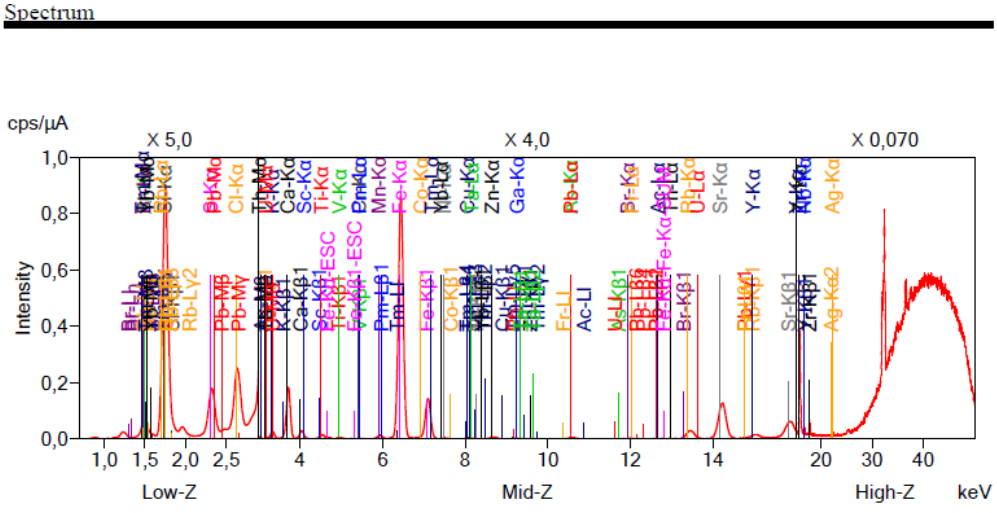
	Studied territories			
	Shumanay district (%)	**Kanlikul district (%)**	**Chimbay district (%)**	**Takhtakupyr district (%)**
Al	9,35	8,91	10,2	7,03
Si	42,6	37,4	35,7	44,5
P	0,0203	0,416	-	0,0185
S	0,366	1,87	1,50	0,220
Ti	1,29	1,21	1,19	1,31
V	0,136	0,148	0,161	0,166
Cr	0,0414	0,0380	0,0493	0,0443
Mn	0,277	0,330	0,343	0,244
Fe	11,2	12,4	14,8	9,26
Ni	0,0226	0,0259	0,0270	0,0171
Zn	0,0208	0,0475	0,0329	0,0179
As	0,0045	0,0084	0,0095	0,0055
Zr	0,0688	0,0525	0,0437	0,100
Nb	0,0056	0,0046	0,0047	0,0057
Ag	-	-	0,0035	-
Ir	-	-	-	0,0044
Ru	-	0,0017	-	-
Pb	0,0029	0,0028	-	-
Cl	0,209	0,354	0,972	0,166
K	4,52	4,65	4,93	5,12
Ca	27,7	29,6	27,7	29,2
Sc	1,40	1,53	1,50	1,58
Ga	0,0050	0,0046	0,0053	0,0042
Br	0,0011	0,0059	0,0029	0,0011
Rb	0,0333	0,0389	0,0477	0,0422
Sr	0,145	0,224	0,183	0,137

Y	0,0109	0,0112	0,0104	0,0105
Tm	0,103	0,131	0,132	0,0941
Th	0,470	0,454	0,466	0,653

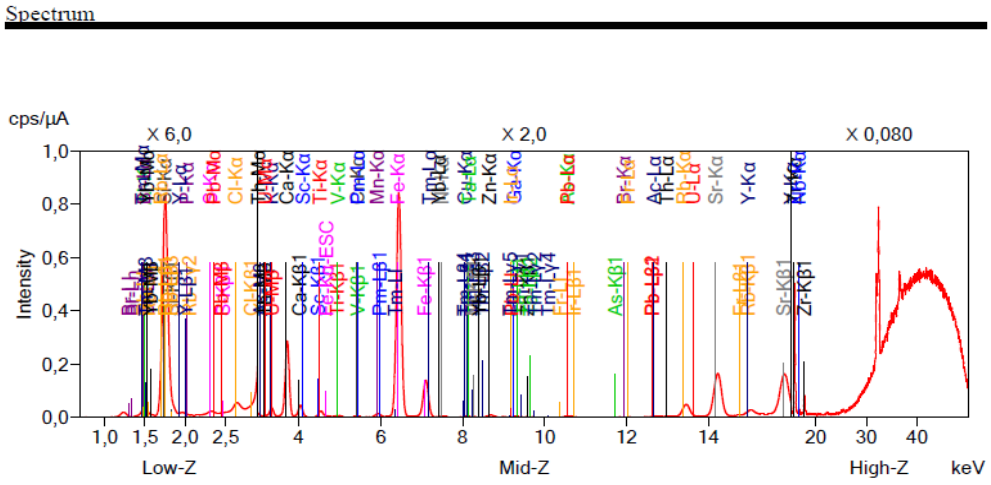
Like the human body, calcium plays a very important role for plants, as it directly participates in their development, ensuring balanced nutrition and growth. In particular, the substance is involved in metabolic processes, carbohydrate and protein component exchange. It is also impossible to achieve the correct structure of the cell walls without it. Calcium deficiency leads to a decrease in the absorption of starch and proteins, which are important for young leaves and growing shoots. According to our results, the Ca content in all studied areas ranges from 27.7 to 29.6% (Table 1).



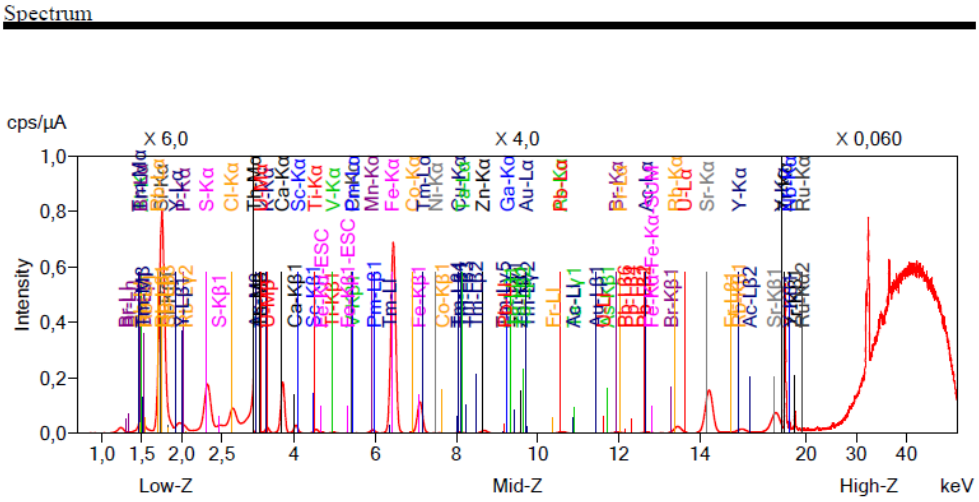
Shumanay district of the Republic of Karakalpakstan



Chimbay district of the Republic of Karakalpakstan



Takhtakupyr district of the Republic of Karakalpakstan



Kanlikul district of the Republic of Karakalpakstan

Figure 3. The results of the spectral analysis of the content of chemical elements in soils in various regions of the Republic of Karakalpakstan

Conclusion

Therefore, when assessing the ecological state of soils, it is important to distinguish between different types of soil degradation: physical, chemical, microbiological, as well as complex types of degradation. Ecological monitoring serves as a good tool for monitoring the state of soils and monitoring their degradation. The practice of using quantitative indicators of soil condition is becoming widespread. Therefore, the most important factor in the environmental safety of fertilizer application is the scientifically sound planning of fertilizer application.

The calculation of optimal doses, taking into account specific soil-climatic and economic conditions, plays a central role in planning. At the same time, the highest efficiency of fertilizer application is achieved where all necessary recommendations are followed, fertilizers are applied in accordance with the biological requirements of plants, taking into account the nutrient content of the soil.

The reclamation state of irrigated lands depends on many natural factors, and in most cases on human intervention, large-scale research is necessary. This requires a careful approach to their analysis and evaluation, as well as the adoption of appropriate preventive solutions when conducting soil protection and other agro technical measures.

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Boundary Value Problem for the Holmgren Equation with a Singular Coefficient in the Right Half-plane

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Abstract
In this paper, a boundary value problem for an elliptic equation degenerating within the domain is studied. By applying the Hankel transform and the method of separation of variables, the solution to the Dirichlet problem is presented in explicit form. The problem under study is equivalently reduced to solving a singular integral equation with a Cauchy kernel. Using the Carleman-Vekua method, its solution is found in explicit form.

Keywords: Bessel Function, Carleman-Vekua Method, Index of the Equation, Singular Integral Equation, Vertical Strip

Introduction

According to the Singular partial differential equations, appear during the study of several of aerodynamics and gas dynamics and irrigation problems. The Dirichlet problem and a Neumann-type problem for an elliptic equation in a vertical semi-strip were studied in. A Neumann-type boundary value problem for the Holmgren equation with a singular coefficient and a spectral parameter was solved in. A nonlocal problem for a class of equations of mixed type was investigated in.

Methodology

Consider the equation

$$|y|^m u_{xx} + u_{yy} - \frac{m}{2y} u_y = 0, m > 0 \qquad (1)$$

in the domain $D = D^+ \cup D^- \cup I$

where $D^+ = \{(x, y) : x > 0, y > 0\}$

$D^- = \{(x, y) : x > 0, y < 0\}$

$I = \{(x, y) : x > 0, y = 0\}$

In the domain D we study the following boundary value problem for equation.

Problem D. Find a function $u = u(x, y)$ in the domain D satisfies the following conditions:

1. $u(x,y) \in C(\bar{D}) \cap C^2(D^+ \cup D^-)$ and satisfies equation (1) in $D^+ \cup D^-$;
2. $\lim\limits_{R\to\infty} u(x,y) = 0, \quad R^2 = x^2 + \dfrac{4}{(m+2)^2}|y|^{m+2}$ (2)
$x > 0, y \in (-\infty, \infty)$;
3. $u = u(x,y)$ satisfies boundary conditions
$u(0,y) = \varphi(y), y \in (-\infty, +\infty)$ (3)
and the transmisson condition
$$\lim_{y\to+0} y^{\beta_0} u_y = \lim_{y\to-0} (-y)^{\beta_0} u_y, \quad x \in (0,\infty) \tag{4}$$
where these limits as $x = 0, x = \infty$ may have singularities of order less than one, where
$$\varphi(y) = \begin{cases} \varphi^+(y), & y \in (0,\infty), \\ \varphi^-(y), & y \in (-\infty, 0), \\ 0, & y = 0, \end{cases}$$
and
$\varphi^+(y) \in C[0,\infty), \quad \varphi^-(y) \in C(-\infty, 0]$,
$\varphi^+(0) = \varphi^-(0) = 0, \quad \varphi(\infty) = 0$.
In this work, we will apply the method of integral equations.

Findings and Discussion

Theorem. Suppose that conditions
$$y^{\frac{m}{2}} \varphi^+(y) \in L(0,\infty), \quad (-y)^{\frac{m}{2}} \varphi^-(y) \in L(-\infty, 0)$$
are satisfied. Then, problem D is uniquely solvable.

Conclusion

In this paper, the Dirichlet problem for the Holmgren equation with a singular coefficient in a half-plane is studied. The proof is carried out using the method of integral equations. The problem is reduced to solving a singular integral equation, and its solution is obtained in closed form via the Carleman-Vekua method.

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Disruption of Ecological Systems Caused by Soil Salinization in the Aral Sea Region

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Abstract

This article examines the disruption of ecological systems resulting from soil salinization in the Aral Sea region. The study focuses on the physicochemical and agrochemical characteristics of irrigated meadow–alluvial soils, with particular attention to the degree and types of salinity. The findings reveal that soil salinization varies significantly across different territories and soil depths. These variations contribute to the deterioration of soil fertility and adversely affect the stability and functioning of local ecosystems. The results highlight the growing environmental challenges associated with salinization and emphasize the need for sustainable soil management strategies in the region.

Keywords: Aral Sea Region, Ecological Disruption, Meadow–Alluvial Soils, Soil Fertility, Soil Salinization

Introduction

Soil is one of the most important natural resources for humanity, as it supports plant growth, regulates water circulation, contributes to the carbon cycle, and sustains biodiversity. However, in recent decades, soil degradation driven by human activities has accelerated significantly. Among the major forms of degradation, soil salinization is a critical factor that directly disrupts ecological systems.

Salinization refers to the accumulation of soluble salts—primarily sodium, magnesium, and calcium—in the soil. Saline soils not only reduce agricultural productivity but also negatively affect vegetation, fauna, and soil microorganisms.

Central Asia, particularly the Republic of Uzbekistan and the Republic of Karakalpakstan, is among the regions most severely affected by salinization. As a consequence of the Aral Sea crisis, hundreds of thousands of hectares of land have become saline, leading to a significant decline in soil fertility.

Review of Related Literature

Research on soil salinization and degradation in the Aral Sea region and Karakalpakstan highlights both local and global perspectives. Saidova and Usmonova (2019) examined the agrochemical indicators of saline irrigated soils in Karakalpakstan, noting the negative impact of salinity on soil fertility and crop productivity. Similarly, Nauryzbaeva (2021) analysed degraded soils in Karakalpakstan, emphasizing the urgent need for restoration measures to sustain agricultural development in the region.

Global studies provide a broader framework for understanding salinization. The FAO (2021) published a global map of saline soils, identifying salinity as a widespread challenge affecting food security and sustainable land use. Lal (2015) argued that restoring soil quality is essential to mitigate degradation, linking soil health to broader sustainability goals. Qadir et al. (2014) explored the economic dimensions of salt-induced land degradation, showing that salinity not only reduces productivity but also imposes significant financial burdens on communities and nations.

The ecological consequences of salinization are closely tied to the Aral Sea disaster, as described by Micklin (2007), who documented how water mismanagement and environmental decline accelerated soil degradation in the region. More recent work by Otenova and Mambetullaeva (2024) provided an ecological assessment of soil salinization in the southern Aral Sea region, highlighting the ongoing environmental risks and the need for sustainable management strategies.

Taken together, the literature demonstrates a dual focus: localized studies in Karakalpakstan that detail the chemical and ecological impacts of salinization, and global research that situates these challenges within broader environmental, economic, and sustainability contexts. This convergence underscores the importance of integrating soil restoration, salinity management, and sustainable land use to address the pressing issue of soil degradation in the Aral Sea region and beyond.

Figure 1. Synthesized image from NASA satellite data (1989–2014)

Objectives

This study aims to investigate the impact of soil salinization as a critical form of degradation that disrupts ecological systems and agricultural productivity. Since soil is one of humanity's most vital natural resources—supporting plant growth, regulating water circulation, sustaining biodiversity, and contributing to the carbon cycle—the objective is to analyze how the accumulation of soluble salts such as sodium, magnesium, and calcium alters soil quality and reduces its ecological and economic value.

Another objective is to explore the broader consequences of salinization on vegetation, fauna, and soil microorganisms. By examining these interconnected effects, the study seeks to highlight the urgent need for sustainable soil management practices. Ultimately, the research intends to provide insights into strategies for mitigating salinity, restoring

soil health, and ensuring the long-term resilience of ecosystems and agricultural systems in vulnerable regions.

Methodology

The research was conducted in the central and southern regions of Uzbekistan, which are characterized by an arid climate and shallow groundwater levels. Soil samples were collected from depths of 10 cm and 30 cm in field conditions, and their physicochemical properties were analysed in the laboratory.

The study employed the following methods: physicochemical analysis, measurement of pH and electrical conductivity (EC), and statistical analysis. Additionally, irrigation practices and groundwater levels were monitored during the research. These approaches enabled the assessment of soil salinity levels, the distribution of chemical elements, and their variation under environmental influences.

Analysis

Analysis of soil salinity demonstrated that both the degree and type of salinity vary across locations and soil depths.

- In irrigated soils of the experimental farm of the Karakalpak Research Institute of Agriculture (Section 1), salinity levels were generally low. Within the 0–50 cm soil layer, salt content remained relatively low, and pH values were around 8.0, indicating an alkaline environment. The dominant salinity types were sulfate and chloride–sulfate.
- In the irrigated soils of the “Kenges” massif (Section 2) in the Chimbay district, salinity levels were also low, with minimal salt accumulation across all depths. The pH remained approximately 8.0, and the predominant salinity type was chloride–sulfate.
- In the soils of the “Tazajol” massif (Section 3), salinity levels were higher, reaching moderate levels. Salt accumulation was particularly pronounced in the 10–30 cm layer. The dominant salinity type was chloride–sulfate, and vertical accumulation processes were evident in the soil profile.

Findings and Discussion

The results indicate that several regions in Central Asia exhibit high levels of soil salinity, with the most severe conditions observed in the Republic of Karakalpakstan and the Khorezm region.

Field studies conducted on meadow–alluvial soils in the Chimbay district of the Republic of Karakalpakstan revealed that the genetic characteristics of these soils are closely linked to fluvial deposition processes, relief, parent material, vegetation cover, climatic conditions, groundwater depth, and salinity level. Significant changes in the agrochemical and physicochemical properties of soils under the influence of salinization were observed.

Table 1 Salinity Status of The Studied Soils

Sect	dept	Dry re	Total HCO_3	Cl^-	SO_4	Ca	Mg	Anion	Na+K		sum of com	pH	Salinity

ion number	hcm	mining part	%/mg/eq	% / mg/eq					mg/eq	%	components		type	level
Irrigated soils of the experimental farm of the Karakalpakstan Scientific Research Institute of Farming														
1	0-10	0,430	0,029	0,021	0,226	0,016	0,001	5,78	4,88	0,112	0,405	8,0	-S-	low
			0,48	0,6	4,7	0,8	0,1	0,9						
	10-20	0,482	0,027	0,028	0,254	0,020	0,004	6,54	5,24	0,121	0,454	8,0	-S-	low
			0,44	0,8	5,3	1,0	0,3	1,3						
	20-30	0,928	0,032	0,028	0,533	0,016	0,004	9,42	9,32	0,260	0,873	8,0	-S-	low
			0,52	0,8	1,1	0,8	0,3	1,1						
	30-50	0,179	0,037	0,014	0,072	0,008	0,012	2,5	1,1	0,025	0,168	8,0	X-S	low
			0,6	0,4	1,5	0,4	1,0	1,4						
Irrigated soils of the "Kenges" massif of Chimbay district														
2	0-10	0,280	0,015	0,028	0,139	0,012	0,007	3,94	2,74	0,063	0,264	8,0	X-S	average
			0,24	0,8	2,9	0,6	0,6	1,2						
	10-20	0,180	0,019	0,043	0,058	0,018	0,012	2,72	0,82	0,019	0,169	8,0	X-S	low
			0,32	1,2	1,2	0,9	1,0	1,9						
	20-30	0,2487	0,019	0,035	0,110	0,014	0,015	3,62	1,72	0,040	0,233	8,0	X-S	low
			0,32	1,0	2,3	0,7	1,2	1,9						
	30-50	0,263	0,019	0,035	0,115	0,010	0,006	3,72	2,72	0,063	0,248	8,0	X-S	average
			0,32	1,0	2,4	0,5	0,5	1,0						
Irrigated soils of the "Tazajol" massif of Chimbay district														
3	0-10	0,421	0,032	0,057	0,182	0,028	0,009	5,92	3,82	0,088	0,396	8,0	X-S	average
			0,52	1,6	3,8	1,4	0,7	2,1						
	10-20	0,564	0,039	0,064	0,264	0,026	0,017	7,94	5,24	0,121	0,531	8,0	X-S	average
			0,64	1,8	5.5	1,3	1,4	2,7						
	20-30	0,554	0,037	0,043	0,283	0,026	0,017	7,7	5	0,115	0,521	8,0	X-S	average
			0,6	1,2	5,9	1,3	1,4	2,7						

	30 - 50	0,352	0,044	0,035	0,149	0,016	0,006	4,82	3,52	0,081	0,331	8,0	X-S	average
			0,72	1,0	3,1	0,8	0,5	1,3						

Overall, the degree of salinity in the studied soils ranged from low to moderate, varying by location and depth. Across all sites, alkaline conditions (pH ≈ 8.0) prevailed, and sulfate as well as chloride–sulfate salinity types were dominant.

Conclusion

The study demonstrates that soil salinity in the investigated regions varies from low to moderate levels, with sulfate and chloride–sulfate types predominating. Salinization significantly alters the physicochemical properties of soils, leading to reduced fertility and destabilization of ecosystems. Therefore, the development and implementation of effective measures to control and prevent soil salinization are of critical importance.

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The Unit of the Mythological Concept “Adam” in the Dictionary of Mahmud Kashgari and its Interpretation in Karakalpak Culture

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Abstract
This article analyses the mythological concept of “adam” in Mahmud Kashgari’s “Divanu Luğat-it-Turk”, which reflects the worldview of the Turkic peoples of the 11th century. The concept of “adam” reveals a person not only as a biological being, but also as a spiritual-moral and socio-cultural phenomenon. The authors identify the religious-mythological and socio-cultural meanings of the concept and analyse it through the oral works of the Karakalpak people - proverbs, epics, folklore texts. The article shows that the interpretation of the image of “adam” in Karakalpak culture is inextricably linked with ancient Turkic archetypes, and at the same time is enriched with a national worldview. The results of the research serve to determine the conceptual continuity, as well as ethno cultural identity in the “man - society - myth” system.

Keywords: Conceptosphere, Karakalpak Culture, Mythology, The Concept of “Adam”, Turkic Peoples

Introduction

Sustainable In his fundamental work, “Divanu luǵat-it-Turk”, Mahmud Kashgari not only laid the foundations of Turkic lexicography but also captured a rich cultural and mythological heritage reflecting the worldview of the Turkic tribes of the 11th century. Among the key concepts, a special place is occupied by the unit of the mythological concept “adam”, which symbolizes not only man as a biological being, but also as a spiritual, moral and socio-cultural phenomenon. In the Kashgari dictionary, “adam” appears as a central category of the Turkic concept sphere, closely connected with ideas about fate, honor, sacrifice and spiritual purity (Камилова, 2024), (Хазиева, 2016).

For Karakalpak culture, the concept of “adam” has both a universal and ethnically specific meaning. In folk proverbs, epic tales, and folklore texts, the image of a person is revealed through collective values—family honor, social prestige, harmony with nature, and spiritual perfection. The works of modern researchers (G.K. Kdirbaeva, V.J. Usenova) show that in the Karakalpak mythological concept sphere the image of “adam” retains a connection with ancient Turkic archetypes, but at the same time is enriched with specific elements reflecting the national worldview.

The relevance of this research lies in the fact that studying the mythological concept unit “adam” allows us to identify the continuity of the cultural and ideological codes recorded by Kashgari and trace their interpretation in the Karakalpak tradition.

The purpose of this article is to examine the specific representation of the concept “adam” in Mahmud Kashgari’s dictionary and analyze its interpretation in Karakalpak culture. The objectives of the study include: 1) identifying the religious, mythological, and sociocultural meanings of the concept “adam” in “Divanu luǵat-it-Turk”; 2) comparing these meanings with Karakalpak folklore and literary sources; 3) determining the universal and ethno specific components of the concept in the Karakalpak worldview.

Review of Related Literature

Research on “Divanu luǵat-it-Turk” and the concept of “adam” in the historical and philological context of Mahmud Kashgari’s “Divanu luǵat-it-Turk” (1072-1074) occupies a special place in the history of Turkic philology, as it is the first encyclopaedic dictionary of Turkic languages created in the Arabic written tradition. Scholars have repeatedly noted that this work is not limited to a description of vocabulary, but represents a comprehensive text capturing the ethno cultural realities, mythological beliefs, and social norms of the Turkic peoples of the 11th century (Камилова, 2024).

According to S.E. Kamilova, Kashgari’s work can be considered “the first philological text of Central Asia”, as it combines not only lexicographic description but also ethnographic, religious, and mythological layers, making it a unique source for studying the worldview of medieval Turks (Камилова, 2024). In this context, the concept of “adam” appears as not simply an anthroponymic unit, but a cultural code reflecting the connection between man and society, religion, and nature.

The concept of “human” in the Turkic worldview, primarily as reflected in an analysis of Kashgari’s dictionary, reveals that the word “adam” has a multilayered meaning. It denotes not only the individual as a biological subject but also a person as a bearer of spiritual and moral qualities. In a number of proverbs and sayings recorded in the “Divan”, “adam” is contrasted with the animal world, symbolizing reason, speech, and social responsibility. M. Kashgari emphasized that it is the capacity for rational speech that distinguishes humans from other creatures, and this idea fits seamlessly into the anthropocentric tradition of Turkic cultures (Исабекова, 2017).

Moreover, in the dictionary’s texts, man is often conceptualized as a mediator between the earth and the heaven. A.I. Pylev, examining the mystical poetry included in the “Divan”, notes that early Turkic notions of man are closely linked to Islamic mysticism, where the individual is viewed as the intersection of earthly existence and the divine order (Пылев, 2015). Thus, “adam” in the Kashgari dictionary carries a sacred meaning, acting as the bearer of the divine spirit and a higher purpose.

Religious and mythological semantics play a role in the interpretation of the concept of “man”. A.A. Khazieva, analyzing the dictionary corpus, emphasizes that terms related to religion and mythology form a semantic field around “adam”, where concepts of purity, spiritual fortitude, fate, and moral choice intersect (Хазиева, 2016). In this regard, “adam” in the Turkic tradition simultaneously functions as an earthly and sacred being.

Objectives

This is especially important for understanding the role of humans in Karakalpak culture, where the image of “adam” retains mythological connotations. Karakalpak proverbs (“Adamdı adam qıladı – sóz”, “Adamdı baylıq emes, aqıl asıraydı”) reflect the same idea: humans do not exist in isolation, but as bearers of reason, speech, and spiritual values.

The linguistic personality of Mahmud Kashgari and the concept of “adam” in U.K. Isabekova’s research reveal the image of Mahmud Kashgari as a “linguistic personality in the dialogue of medieval cultures” (Исабекова, 2017). The scholar emphasizes that Kashgari consciously integrated the Arab-Islamic tradition with Turkic culture, thereby forming a unique system of categories. In this system, “adam” appears as a universal concept linking the traditions of Islamic anthropology and Turkic mythopoetics. Thus, “Divan” becomes not only a lexicographic source, but also a philosophical and cultural text, where the concept of “man” acts as a point of intersection of various ideological traditions.

The study of the image of “adam” in the Kashgari dictionary is fundamental importance for Karakalpak philology. Modern research (G.K. Kdirbaeva, V.J. Usenova) shows that in the Karakalpak concept sphere, “adam” retains a dual structure: universal (common Turkic) and ethno specific. A comparative typological perspective on the Kashgari and Karakalpak materials reveals that the concept of “adam” in both cases is rooted in mythological foundations, but its interpretation differs in emphasis. In the “Divan”, it functions primarily as a lexical-semantic unit, embedded in the system of Islamic and pre-Islamic beliefs. In Karakalpak culture, however, this image acquires a more pronounced ethical and social connotation, being embodied in proverbs, fairy tales, and epic works.

Thus, examining the concept of “adam” in the “Divanu luǵat-it-Turk” and comparing it with the Karakalpak tradition opens new horizons for understanding the ethno cultural identity of the Turkic peoples.

Methodology

The mythological concept of man in the Turkic tradition is linked to the mythological consciousness of the Turkic peoples, which has always focused on man as the central element of the universe. Researchers note that anthropocentrism is a pervasive feature of Turkic mythopoetics: man acts as a mediator between the cosmos and society, the sacred and the earthly. The works of classic mythologists (M. Eliade, C. Lévi-Strauss, C.G. Jung) indicate that man plays the role of a mediator in mythological space, who, through rituals and symbolic actions, ensures harmony between worlds (Eliade, 2002), (Lévi-Strauss, 1985).

This approach is fully characteristic of Turkic cultures. The concept of “adam” is formed not as an isolated concept, but as the core of a mythological conceptosphere, including the categories of fate (táǵdir), happiness (baxıt), spiritual purity (tazalıq), sacrifice (párawanlıq), and social prestige (abıroy). These concepts are largely reflected in both the Kashgari dictionary and the Karakalpak tradition. Man and Cosmology in Turkic mythology, man is understood as part of the cosmos, whose existence is determined by interaction with heaven (kók aspan) and earth (jer). In epic texts and proverbs, “adam” is often associated with celestial bodies, symbolizing its subordination to higher powers. For example, in Karakalpak fairy tales, the hero’s fate is described through the “juldız”

(star), which indicates his life path. These ideas find a direct parallel in the “Divan”, where Kashgari records numerous expressions linking humans to celestial bodies. A.I. Pylev rightly notes that this connection has a mystical basis: humans not only live in the world but also bear the “imprint of the heavenly order” (Пылев, 2015). The ethical dimension of the concept of “adam” in the Turkic tradition places particular emphasis on human moral and ethical qualities. In proverbs and sayings, “adam” is not simply a biological being, but a bearer of reason, honor, valour, and social responsibility. For example, the expression “Adamnıń abıroyı – eldiń baylıǵı” (“A person's honor is the wealth of the nation”) is widespread in Karakalpak folklore.

A.A. Khazieva emphasizes that in the religious and mythological vocabulary of Kashgar, the category “adam” is closely linked to notions of spiritual purity and virtue (Хазиева, 2016). Humans are conceived as beings called upon to observe religious norms and thereby maintain balance in the world. Thus, the concept of “adam” in the Turkic tradition has a clearly expressed ethical dimension: to be human means to be a bearer of moral values that reflect the collective consciousness of the people. One of the key aspects of the mythological concept of “adam” is its connection to society. In Turkic cultures, the individual is inseparable from the clan (urıw), family (shańaraq), and community (jámiyet). In folklore texts, “adam” is understood primarily through social relations: “without clan, there is no man”.

In the Kashgari dictionary, this aspect is manifested through numerous proverbs emphasizing the value of collectivism and social unity. U.K. Isabekova notes that Kashgari consciously recorded expressions reflecting the relationship between the individual and the collective, making the “Divan” not only a dictionary but also a unique “sociocultural code” of the medieval Turks (Исабекова, 2017). Modern Karakalpak studies confirm the continuity of this tradition. G.K. Kdirbaeva points out that for the Karakalpaks, “adam” is not only an individual but also a “bearer of social prestige”, expressed in the category of prestige. In this sense, the concept of “adam” functions as a link between the individual and society, reflecting the idea of harmony within the collective.

A comparison of Karakalpak material with other Turkic traditions (Uzbek, Kazakh, and Bashkir) reveals both common and specific features of the concept of “adam”. L.R. Suleimanova, examining Turkic vocabulary in the terminology of Bashkir funeral and memorial rites, notes that “adam” in this context symbolizes not only life but also the transition to another world (Сулейманова, 2017). Similar semantic parallels can be found in Karakalpak culture, where death and human destiny are viewed as part of a single cosmic cycle. Thus, the universal Turkic concept of “adam” is imbued with local meanings that reflect the specificity of each ethnic tradition.

The mythological concept of “adam” in the Turkic tradition has a multilayered structure. It includes:

1. The cosmological dimension – man as part of the universe, connected to heaven and earth.
2. The ethical dimension – man as the bearer of honor, spiritual purity, and moral standards.
3. The social dimension – man as a member of a clan and society, whose value is determined by collective ties.

These aspects were recorded in the “Divanu luǵat-it-Turk” and are reflected in Karakalpak culture, demonstrating a strong continuity between the ancient Turkic heritage and modern ethnocultural realities.

Analysis

Karakalpak culture and its interpretation of the concept of “adam” have preserved unique layers of mythological worldview in their folklore, where the concept of “adam” occupies a central place. In proverbs, fairy tales, epics, and rituals, humans are portrayed as the foundation of the universe, the bearer of spiritual values, and the mediator between the cosmos and society. Scholars of Karakalpak philology (J. Yeshbaev, Sh. Kunnazarova, G. Kdirbaeva) point out that “adam” in folk tradition is interpreted not only as a physical personality but also as a “mythological category” uniting moral, social, and sacred qualities. This characteristic is evident in Karakalpak proverbs: “Adamdı adam qıladı – sóz” (“A man is made man by his words”), “Adamnıń abıroyı – eldiń baylıǵı” ("A man’s honor is the nation’s wealth"), “Adam ólse – atı qaladı” (“A man dies, but his name remains”). In these expressions, a person is understood through speech, honor, and a good name—that is, through values that have collective significance.

The interpretation of “adam” in the Karakalpak mythological conceptosphere in the field of cognitive and ethnolinguistic (G.K. Kdirbaeva & V.J. Usenova, 2024) shows that in the Karakalpak conceptosphere, “adam” functions as a key mythologeme, reflecting the unity of spiritual and social principles. G.K. Kdirbaeva notes that the concept of “adam” in the Karakalpak language is closely connected with such concepts as baxıt (happiness), páráwanlıq (sacrifice), jámiyetlik abıroy (social prestige). These categories form a semantic field around “adam” similar to those found in “Divanu luǵat-it-Turk” (Кдырбаева, 2024). V. J. Usenova, studying fairy tale discourse, emphasizes that a human in Karakalpak tales is presented as a bearer of collective values and moral guidelines. In her interpretation, “adam” is a “symbolic hero embodying the destiny of the people, their spiritual aspirations, and social ideals” (Усенова, 2024).

Karakalpak literature of the 20th and 21st centuries also retained the interpretation of humans as a moral category. In the works of Ajiniyaz, T. Kaipbergenov, and other writers, the image of “adam” is closely linked to the concepts of conscience, duty, and honor. The literary heroes of these authors demonstrate that being human means not only living but also serving society and the people. This understanding reflects the traditional Karakalpak worldview: “adam” is “jámiyettiń bir aǵzası” ("an individual who benefits society"). This ethical burden connects modern literature with the mythological tradition, in which a person was always judged by their actions and social role. A comparative analysis shows that many of the meanings recorded by Kashgari in the 11th century continue to exist in Karakalpak culture. For example, speech as a criterion of humanity is noted in the “Divan” “adam” is distinguished by word (sóz) and intelligence. This idea is repeated in Karakalpak proverbs: “A man is made human by his word”. In Karakalpak culture, “abıroy” (prestige) remains the most important characteristic of “adam”. The dictionary “Memory and Name” contains sayings about the immortality of a person’s name. In the Karakalpak tradition, the proverb “Adam ólse – atı qaladı” confirms the same idea.

Thus, we can speak of a profound continuity of cultural codes, where “adam” is a stable concept that has retained its archetypal foundation over the centuries. An important component of the interpretation of “adam” in Karakalpak culture is its sacred aspect. Religious rites associated with birth, marriage, and death have always emphasized the

uniqueness of humans as beings connected to higher powers. Initiation rites (súnnet toy), funeral rituals, and wedding songs, humans are viewed as a link between the past and future generations.

Here, it is appropriate to turn to the research of L.R. Suleimanova, who studied Turkic vocabulary in Bashkir funeral and memorial rites. She demonstrated that “adam” in these contexts symbolizes not only life but also the transition to the next world (Сулейманова, 2017). Similarly, in Karakalpak culture, a person’s death is perceived as a continuation of his life’s journey in space, which confirms the mythological nature of the concept. The social portrait of “adam” in the Karakalpak tradition in the “Divan” is often presented in a generalized form, but in Karakalpak culture this concept is imbued with specific social characteristics. Thus, in folklore and ethnographic texts, traits such as reason and speech, which verbalize the ability to speak and think (“Sóz – adamdı adam qıladı”), are highlighted. Honor and prestige as the social evaluation of an individual (“Abıroy – eldiń baylıǵı”). Memory and name—as a person lives as long as their name lives in society. Sacrifice and responsibility—as a person is obligated to care for family, clan, and community. The interpretation of the concept of “adam” in Karakalpak culture represents a complex interweaving of universal Turkic archetypes and local ethnocultural characteristics. While the “Divanu luǵat-it-Turk” conceptualizes man as a spiritual and social being, in the Karakalpak tradition this image is further developed, being enshrined in proverbs, epics, rituals, and literary works.

Thus, “adam” becomes a key category through which ethnic identity is formed and the system of moral and ethical values of the Karakalpak people is consolidated. Modern cognitive-discursive approaches to the concept sphere of “human” increasingly focus on the human as a central category in language and culture. According to the anthropocentric paradigm (Sh. S. Safarov, N. M. Djusupov, E. S. Kubryakova), language not only reflects but also shapes an individual’s worldview. The concept of “adam” in Turkic languages, including Karakalpak, is a striking example of how lexical and semantic units serve as a representation of ethnocultural values.

Research in cognitive linguistics shows that the concept of “human” functions in language through a system of metaphors, symbols, and discursive practices. Thus, J. Lakoff and M. Johnson, in their theory of conceptual metaphor, noted that human perception and thought are structured metaphorically (Lakoff & Johnson, 1980). In this context, “adam” in the Karakalpak tradition can be viewed as a universal metaphor for human existence, uniting spiritual and social layers. In her doctoral research, G.K. Kdirbaeva emphasizes the cognitive-discursive approach to Karakalpak philology, the mythological concept sphere, including the image of man, is realized through various types of discourse: artistic, folkloric, and religious. According to her, “adam” is a “cognitive node” that connects universal archetypes and local cultural stereotypes. For example, Karakalpak concepts such as teńiz jolı (sea route), waqıt ólshemi (measurement of time), and jámiyetlik abıroy (social prestige) form a symbolic field around “adam”, allowing it to be viewed as a mediator between nature and society.

V. J. Usenova’s PhD dissertation also demonstrates that the concept of “adam” in fairy tale discourse is linked to a system of symbols representing the individual’s life journey. She argues that fairy tales shape a “human paradigm” through oppositions: good/evil, strength/weakness, and honor/shame. This reflects not only mythological consciousness but also the collective code of the Karakalpak people, where the image of “adam” is

always imbued with moral content. Cognitive-discursive approaches allow us to consider “adam” not only as a linguistic unit but also as a sociocultural phenomenon. In this regard, the research of M. M. Makovsky, Yu. M. Lotman, and V. N. Toporov highlights the role of text and discourse in the formation of concepts. Yu. M. Lotman wrote that “a person in a text is not just a character, but a cultural symbol” (Lotman, 1998).

This is especially significant for Karakalpak culture: every text—proverb, song, epic—captures the image of the individual as a “symbol of culture”. As a result, a stable mythological model is formed, where “adam” represents not only a biological being but also a bearer of spiritual experience, collective memory, and traditions. Modern Karakalpak literature and media preserve and transform this traditional image of the individual. In television and radio programs, educational projects, and public initiatives, “adam” continues to be conceptualized as a symbol of morality, justice, and spiritual strength. Thus, according to G.K. Kdirbaeva, in contemporary discourses (media, educational texts), “adam” becomes “the key to cultural identity”, confirming the relevance of its study from a cognitive perspective.

Furthermore, researchers note that globalization and digitalization are creating new forms of representation for the concept of “adam”. In the context of intercultural dialogue, it acquires transnational characteristics while preserving national meanings. This is particularly important for the Karakalpak people, where the preservation of ethnocultural values is linked to the stability of the concept of “adam” as a bearer of memory and tradition. A comprehensive analysis of modern research allows us to identify universal and ethno specific characteristics of the concept of “adam”, such as universality in connection with the universe, sacredness, moral norms, and family memory. Ethnospecific (Karakalpak) emphasis on abıroy (prestige), collective identity, and the interconnectedness of the individual and society, expressed in proverbs and epics.

Thus, cognitive-discursive analysis confirms that the concept of “adam” is a stable cultural construct that has maintained continuity with “Divanu luǵat-it-Turk” and has found new development in Karakalpak culture.

The results of the literature review revealed that:

1. In Mahmud Kashgari’s “Divanu luǵat-it-Turk”, the concept of “adam” is recorded as a lexical-semantic and cultural unit associated with religion, mythology, and society.
2. In the Turkic mythological tradition, “adam” appears as a mediator between the sacred and the mundane, a bearer of honor and moral norms.
3. In Karakalpak culture, the concept of “adam” maintains continuity with the Kashgari heritage, but is enriched with ethno specific features associated with collectivism, honor, and social responsibility.
4. Modern cognitive-discursive approaches allow us to consider “adam” as a “cognitive node” of ethno culture, uniting universal archetypes and local values.

Thus, “adam” remains the central concept that shapes the national identity of the Karakalpak people, providing a link between the past, present, and future.

The empirical basis of the study was comprised of:

- dictionary entries, paremias, and folklore texts recorded in Mahmud Kashgari’s “Divanu luǵat-it-Turk” (11th century);

- Karakalpak paremiological collection (proverbs, sayings, and set expressions reflecting the image of "adam");
- epic works ("Qırıq Qız", "Er Qosay", "Alpamıs"), where the image of man is revealed through the archetypes of the hero and the sage;
- ritual texts (funeral, memorial, wedding, and initiation songs) containing ideas about man's place in society and the cosmos;
- modern Karakalpak literary texts, where the concept of "adam" receives new interpretations.

Cognitive analysis was used as a methodological basis (identifying key semantic fields and archetypal structures of the concept "adam"), componential analysis (decomposing the concept into its elementary semes: speech, honor, fate, prestige, and sacrifice), a comparative typological method (comparing Kashgari material with the Karakalpak tradition), and discourse analysis (examining the functioning of the concept "adam" in different types of discourse: folkloric, religious, and artistic).

An analysis of the concept of "adam" in Mahmud Kashgari's dictionary based on the lexical-semantic level in "Divanu luǵat-it-Turk" interprets the word "adam" not only as "human" in the biological sense, but also as "an intelligent being endowed with speech". In several articles, Kashgari emphasizes that "adam" is not simply a living being, but a being endowed with the gift of speech and the ability to distinguish between good and evil. (Камилова, 2024).

Particular attention is paid to phrases in which "adam" serves as a standard or contrast. For example:

- "Adam sózinen tanıladı" – "A man is recognized by his word";
- "Adam malı menen emes, aqılı menen bay" – "A man is rich not in property, but in intelligence".

These sayings demonstrate that for the 11th century Turks, "humanity" was directly associated with intelligence and speech, rather than material wealth.
According to A.A. Khazieva's observations, religious vocabulary in the Kashgari dictionary is closely intertwined with the concept of "adam" (Khazieva, 2016). Humanity is viewed as a creation of Allah, endowed with spirit (ruwx), and therefore, their life acquires a sacred dimension.

Examples from the "Divan" confirm this:

- "Adam – Allanıń amanatı" – "Man is the amanat of Allah";
- "Adamnıń janı – Allanıń nurı" – "The soul of man is the light of Allah".

Such expressions emphasize that man is conceived not only as a social but also as a sacred being.

A.I. Pylev points out mystical and poetic elements that the "Divan" contains the most ancient examples of Turkic Muslim mystical poetry, where a man is presented as a mediator between the earth and the heaven (Пылев, 2015). Thus, in poetic fragments, "adam" is associated with the "star of fate" and the "ray of light" leading to truth.

These elements of mystical symbolism bring the concept of “adam” closer to the universal archetypes of world mythology, where man is always represented as the “path to God” or “traveller between worlds” (Eliade, 2002).

Thus, in the Turkic tradition, the individual was understood not individually, but through their contribution to the life of the clan and community.

The empirical material from “Divanu luǵat-it-Turk” allows us to identify the following components of the concept of “adam”:

1. Speech and intelligence – the criterion of humanity (distinction from animals).
2. Sacredness – man as a creation of Allah, bearer of the spirit.
3. Sociality – man as a member of the clan, custodian of honor and memory.
4. Mysticism – man as a mediator between the earth and the heaven.

These characteristics form the basis of the mythological concept of “adam” in 11th century Turkic culture.

The interpretation of the concept of “adam” in the Karakalpak language and culture within the Karakalpak paremiological fund contains a number of manifestations that reveal the essence of man through the prism of collective values. The most frequent groups of proverbs feature prominently speech, honor, name, and memory. Speech and intelligence: “Adamdı adam qıladı – sóz” (“A man is made by a word”); “Aqıl – adamnıń baylıǵı” (“Intelligence is a man’s wealth”). These proverbs echo formulations from Kashgari, where speech and intelligence play the primary roles in humanization (Камилова, 2024).

Honor and prestige: “Adamnıń abıroyı – eldiń baylıǵı” (“A man’s honor is a nation’s wealth”); “Abıroysız adam – qanatsız qus (“A man without honor is like a bird without wings”). Here, honor is interpreted as the primary criterion of an individual’s social values, which is entirely consistent with the Kashgari’s tradition (Исабекова, 2017).
Name and Memory: “Adam ólse – atı qaladı” (“A man dies, his name remains”), “Jaqsınıń atı ólmeydi” (“The name of the worthy never dies”).These expressions emphasize the idea of collective memory, in which a person lives on through good deeds and public recognition. Thus, Karakalpak proverbs demonstrate the persistence of archetypal meanings recorded in the “Divan”.

Karakalpak heroic epics (“Qırıq Qız”, “Er Qosay”, and “Alpamıs”) present man not simply as an individual, but as a hero, a bearer of strength, wisdom, and social responsibility. In “Qırıq Qız”, warrior girls defend the people, embodying the ideals of sacrifice and patriotism. Here, “adam” is an individual willing to sacrifice themselves for the sake of society. In “Er Qosay”, the hero symbolizes courage and fortitude, but his value is measured not only by his military qualities but also by his honor, wisdom, and ability to lead his clan. In “Alpamıs”, the hero is associated with the idea of overcoming challenges, where a person demonstrates fortitude and loyalty to traditions. These archetypes are consistent with the data in “Divanu luǵat-it-Turk”, where ‘adam” is interpreted as the guardian of social order and spiritual values (Пылев, 2015).

In the ritual culture of the life cycle—birth, marriage, death—the concept of “adam” is revealed in a sacred dimension.

Birth: at the birth of a child, the wish is made: “Adam bolsın” ("May he become a man”). Here, the word “adam” denotes not simply “man”, but a person endowed with virtues, wisdom, and honor. Marriage: at weddings, it is often said: “Eki jas bir-birine tirek bolıp, naǵız adam bolǵay” (“May the young people become true people, a support for each other”). Death, in funeral songs the idea is often heard that a person remains in the memory of the people: “Adam ólse – sózi qaladı” (“When a person dies, his word remains”).

L.R. Suleimanova, analyzing Turkic vocabulary in Bashkir rituals, notes that the category of “adam” is always associated with the transition to another world [Сулейманова,2017: 59].The Karakalpak data confirm the universality of this symbolism. In modern Karakalpak literature, writers (Ajiniyaz, T.Kaipbergenov, M.Yesebayev) continue to develop the traditional image of “adam”, integrating it into new social and cultural contexts. For Ajiniyaz, “adam” is the bearer of conscience and national spirit, a fighter for justice. For T. Kaipbergenov, man is presented as the custodian of historical memory and national dignity. Thus, 20th- 21st- century literature preserves the mythological foundation of the concept of “adam” but imbues it with new realities—patriotism, the struggle for independence, and the preservation of national identity.

A comparison of Kashgari and Karakalpak material reveals a number of parallels. Speech and word in the “Divan”: “A man is known by his word”; in Karakalpak proverbs: “Adamdı adam qıladı – sóz”. Honor and prestige: in the dictionary, honor is recorded as the foundation of personality; in Karakalpak culture, abıroy is a key element of the social portrait. Name and memory in the “Divan”: “The name remains after death”; similar formulas are preserved in Karakalpak proverbs. Sacrifice in the mystical poetry of Kashgari is conceptualized as a mediator between worlds; in Karakalpak epics, heroes sacrifice themselves for the sake of the people.

Thus, we can speak of a direct continuity of cultural codes, where the concept of “adam” retains universal Turkic features, but in the Karakalpak tradition, the social and moral component is strengthened. The interpretation of the concept of “adam” in Karakalpak culture demonstrates the stability of archetypal meanings recorded as early as the 11th century and their transformation in an ethnically specific manner. In paremiology, “adam” is revealed through speech, honor, and memory. In epics, through heroism, sacrifice, and collective responsibility. In rituals, through the sacredness of the life cycle. In literature, through conscience, patriotism, and national identity.

Thus, the image of “adam” remains the core of the Karakalpak concept sphere, reflecting the interplay of the universal and the local, the sacred and the social, the traditional and the modern. Empirical analysis has shown that the concept of “adam” occupies a central place in the Turkic and Karakalpak concept sphere. It represents a complex interweaving of anthropological, ethical, social, and sacred meanings.

In Kashgari’s “Divanu luǵat-it-Turk”, this concept was first recorded as a lexical-semantic unit reflecting collective values. It has been preserved and further developed in Karakalpak culture, becoming a symbol of national identity, honor, and collective memory.

Thus, the study of the unit of the mythological concept “adam” allows us to gain a deeper understanding of the continuity of cultural codes and reveal the mechanisms of formation of the ethno cultural identity of the Karakalpak people.

Findings and Discussion

The concept of “adam” as an archetype of Turkic culture, as analysed in the materials of “Divanu luǵat-it-Turk” and the Karakalpak tradition, revealed that the concept of “adam” is an archetypal and universal element of the Turkic conceptual sphere. It has remained stable for over a millennium, integrating sacred, social, and ethical aspects.

Mahmud Kashgari also noted that a person is defined through speech and intelligence (Камилова, 2024), as well as through the social assessment of society (Исабекова, 2017). These characteristics are reproduced almost unchanged in Karakalpak proverbs. Thus, it can be argued that the image of a person as a bearer of speech and honor is universal throughout Turkic civilization.

The results of the empirical analysis suggest a dual structure for the concept of “Adam”. On the one hand, it is linked to the sacred order—humanity is conceived as a creation of Allah, a bearer of the spirit (ruwx), a trustee of God. On the other hand, it has a social dimension—an individual is valued by society through their actions, name, and honor. This duality is clearly evident in both the “Divan” and Karakalpak texts. In the proverbs “Adam ólse – atı qaladı”, sacredness (the immortality of the name) and sociality (public memory) are combined in a single image. Thus, the concept of “adam” functions as a mediator between the divine and the human, the sacred and the mundane. The ethical component deserves special attention. In both corpora (Kashgari and Karakalpak), being “adam” means not simply being biologically human, but also conforming to moral standards: having honor, keeping one’s word, and caring for one’s people.

This approach confirms the anthropocentric orientation of Turkic culture, where the individual is assessed not individually, but through their social usefulness and moral qualities. In this context, abıroy serves as a key ethno specific marker of the Karakalpak tradition.

A comparative analysis has shown that, although universal archetypes (speech, honor, and name) are common to Turkic cultures, the Karakalpak tradition emphasizes collectivism. It conceptualizes the individual primarily as part of a clan (urıw), a community (jámiyet), and a people (el).

In the epics, heroes embody collective ideals rather than personal ambitions. In “Qırıq Qız”, girls sacrifice themselves for the sake of the people; in “Er Qosay”, and “Alpamıs”, the heroes fight not for personal glory, but for the honor of their clan. This emphasizes that the ethnically specific interpretation of “adam” in Karakalpak culture enhances the social and moral component.

An important feature of the Karakalpak tradition is the epic interpretation of “adam”. In the epics, the image of man is embodied through the archetype of the hero, symbolizing strength, wisdom, and sacrifice. This adds a specific national flavour to the universal concept.

While Kashgari defines “adam” primarily through word and honor, Karakalpaks also define it through heroism and the ability to defend the people. This shift in emphasis reflects historical circumstances: the Karakalpak people have lived for centuries in a struggle for survival, which has predetermined the perception of man as a warrior and protector.

From a cognitive linguistics perspective, the concept of “adam” can be viewed as a “cognitive node” that combines universal and ethnically specific meanings. Its structure distinguishes between universal semes (speech, reason, honor, memory, sacredness) and ethnically specific semes (prestige, collectivism, heroism, sacrifice).

Discourse analysis revealed that “adam” functions in various genres and text types (proverbs, epics, rituals, and literature), maintaining consistent meanings. This confirms the idea that the concept of “adam” is the core of the Karakalpak concept sphere.

Thus, it can be argued that Karakalpak culture preserves common Turkic archetypes but strengthens its socio-moral and heroic-epic components. The study’s results open up new directions: a corpus analysis of Karakalpak parasitology, identifying the frequency of the concept “adam”, a semantic map of the concept in comparison with other Turkic languages, a study of the concept’s transformation in the context of digital culture and globalization, and an examination of the role of the concept “adam” in contemporary media discourses (press, social media, education).

The concept of “adam” is an archetypal element of Turkic culture that has remained stable since the 11th century. It has a dual structure: sacred (connection with Allah, spirit, and destiny) and social (honor, memory, and collectivism). Karakalpak culture enhances the socio-moral and heroic-epic aspects of the concept, making it a central category of ethnic identity. Cognitive-discursive analysis confirms that “adam” is a “cognitive node” linking universal and ethnically specific meanings. Further research should focus on corpus analysis, comparisons with other Turkic cultures, and an examination of the concept’s transformation in contemporary contexts.

Thus, the discussion showed that the unit of the mythological concept “adam” in the dictionary of Mahmud Kashgari and its interpretation in Karakalpak culture form a continuous line of succession that not only preserves the tradition, but also determines the cultural future of the Karakalpak people.

Conclusion

This study provided a comprehensive examination of the mythological concept “adam” in Mahmud Kashgari’s “Divanu luǵat-it-Turk” and its interpretation in Karakalpak culture. An analysis of lexicographic data, paremiological material, epic and ritual texts and contemporary literary works revealed that the image of man is a central element in the ethno cultural concept sphere of Turkic peoples, including the Karakalpaks.

First of all, it should be emphasized that as early as the 11th century, Mahmud Kashgari documented the universal characteristics of the concept of “adam”: the connection between man and speech and intelligence, his sacred nature as a creation of Allah, and his social significance expressed through the categories of honor and memory. These characteristics formed the basis for the concept’s further development in Turkic cultures and have been preserved virtually unchanged in the Karakalpak tradition.

At the same time, analysis of Karakalpak material revealed the presence of distinct ethnic characteristics. In proverbs and sayings, the “adam” is portrayed as a bearer of abıroy (honor and prestige), which is one of the key markers of Karakalpak identity. In epic works, the image of the individual receives a heroic and epic interpretation: they become not only an individual but also a symbol of sacrifice, strength, and patriotism, a fighter for the honor of their clan and nation. In ritual culture, the “adam” appears as a sacred being, whose life and death are understood in the context of cosmic cycles and tradition. A particular significance is the fact that in Karakalpak culture, the individual is always perceived through the collective—family, clan, community, and nation. Collectivism as a value enhances the social dimension of the concept and shapes its ethnically specific character. Thus, the Karakalpak version of the concept of “adam” retains universal Turkic archetypes but emphasizes the social, moral, and heroic components.

From a cognitive-discursive analysis perspective, “adam” is a multilayered concept that functions in various types of discourse: folklore, epic, ritual, and literary. In each of these discourses, it performs different functions – from a native speaker and morality to a hero and symbol of national identity. This multifaceted nature allows us to view “adam” as a “cognitive node” that unites universal and local meanings, tradition and modernity.
The study’s results also demonstrate the importance of the continuity of cultural codes. Despite the millennia-long gap between the “Divan” and modern Karakalpak texts, the concept of “adam” retains its relevance. It continues to be the foundation of the people’s moral and ethical system, a reflection of their ethnic identity, and a symbol of spiritual resilience. Prospects for further research include expanding the corpus of texts studied (including contemporary media and educational discourses), as well as a comparative analysis of the concept of “adam” in Karakalpak and other Turkic languages. This will allow for a deeper understanding of the mechanisms by which archetypal meanings are preserved and transformed in the context of globalization and cultural change.

Thus, the unit of the mythological concept “adam” is not only a linguistic and cultural category, but also a symbol of the continuity, spiritual strength, and resilience of the Karakalpak people.

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Conservation of Biodiversity in Protected Natural Areas of the Aral Sea Region

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Abstract
In the article the questions of the modern state of biodiversity of Southern Priaralie and perspective directions of development of ecological tourism in this region. There is the intensive mastering of territory of plateau Usturt that is accompanied by influence of anthropogenic factors on the dynamics of landscape, vegetable associations and specific variety of fauna.

Keywords: Biodiversity, Eco-tourism, Monitoring, Plateau Usturt, Southern Priaralie

Introduction

Changes in the natural environment of Karakalpakstan under the influence of the ecological crisis have led to the degradation and transformation of all components of the region's ecosystems. Over recent decades, many species of animals and plants have disappeared and continue to disappear, while unique natural complexes are being destroyed, causing significant concern and serious apprehension.

At present, one of the key environmental protection tasks is to ensure the capacity of ecosystems for self-recovery by preventing their transformation beyond permissible limits. Despite the negative impact of human activities on the environment, the inherent ability of natural ecosystems to regenerate makes it possible to continue diverse economic activities associated with anthropogenic influence on nature.

Review of Related Literature

The Southern Aral Sea region, with its vast territory, diverse ecosystems, and rich species composition, requires the development of specialized research aimed at the inventory and assessment of biodiversity, the advancement of monitoring systems, and the formulation of principles and methods for the conservation of natural biosystems.

The issue of the state of faunal biodiversity and its dynamics under conditions of intense aridization in the Aral Sea region requires comprehensive and in-depth study. In this regard, it is necessary to conduct an inventory of the region's biological resources and to develop effective measures and strategies for their conservation.

The system of protected natural areas worldwide attracts particular attention from scientists and specialists. Since the early 1970s, environmental protection has become a prestigious field that enhances the international standing of any state. Many countries have signed international agreements aimed at conserving biological resources threatened with extinction. Protected natural areas (PNAs) provide opportunities to monitor the full diversity of natural resources that can no longer be found in anthropogenic ally transformed territories.

Objectives

The transformation of habitats leads to a reduction in species richness, population size, and the distribution ranges of many species of animals and plants. Biodiversity loss is occurring at a rapid pace. Over the past century alone, large mammal species such as the kulan and the cheetah have disappeared. Species that were once found in the hundreds of thousands—such as the saiga antelope, goitered gazelle, Asian mouflon, and, among birds, the houbara bustard—are now on the brink of extinction.

The task of preserving the diversity of flora, fauna, and soils is of great importance to humanity for various reasons. Many animal and plant species are valuable for agricultural and livestock activities. The conservation of wild species of flora and fauna is essential for enhancing the resistance of cultivated plants and domesticated animals to pests and diseases.

Methodology

A territorial approach to nature conservation should ensure the fulfilment of all functions of protected natural areas (PNAs) while minimizing restrictions on other functions necessary for sustaining human livelihoods. The selection of specific directions for the establishment of newly designated PNAs is determined by several factors, including the current state of natural territories (fauna, flora, and soils) and the dynamics of anthropogenic impact on these areas.

At the same time, the assessment of the current state of protected natural areas is carried out according to the following criteria:
– the presence or absence of large natural areas where the conservation of biota is possible;
– the presence or absence of functional connectivity between protected natural areas;
– the resilience of the natural framework, which is ultimately more significant than the complete absence of any impact on natural ecosystems.

The Ustyurt Plateau is one of the oldest deserts of Eurasia. Its surface is characterized by an elevated plateau with absolute heights ranging from 160 to 300 meters above sea level, bordered on all sides by more or less distinct escarpments, known as “chinks,” with heights of 190–256 meters. Depending on climatic features and physical-geographical conditions, patterns in the structure of vegetation cover and soil salinity within the Karakalpak part of the Ustyurt Plateau reveal the presence of gypsum, saline, and sandy deserts.

The ancient origin and relative isolation of the plateau have led to its distinctive character and a high level of endemism among both fauna and flora. Since the 1960s, the territory of the Karakalpak part of the Ustyurt Plateau has been subject to intensive techno genic, industrial, construction, and economic development associated with the exploration and

extraction of natural gas, oil, and precious metals over many years. The climate of the region is sharply continental, characterized by hot, dry summers and relatively harsh winters accompanied by strong winds, low levels of atmospheric precipitation (70–110 mm per year), unstable snow cover, high evaporation rates, and pronounced temperature fluctuations both seasonally and diurnally.

In recent years, the intensive development of the Ustyurt Plateau has significantly increased the impact of anthropogenic factors—such as the construction of railways, gas pipelines, and related infrastructure—on landscape dynamics, plant communities, species diversity of fauna, and overall biological productivity.

From an ecological perspective, the stability of biota can be assessed using the criterion of the presence of diverse rare taxa (i.e., rare species of living organisms that differ significantly in ecological niches, trophic levels, and the spatial scale required for sustaining their populations) across the full ecological range of their habitats. For many species, such as the saiga antelope and the goitered gazelle, there has been a sharp decline in population numbers, while some species, including the cheetah and the kulan, have completely disappeared from the region's faunal complex.

These species are listed in the Red Data Book of the Republic of Uzbekistan, the IUCN Red List, and the Appendices of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), to which the Republic of Uzbekistan is a party. In weakly disturbed natural communities capable of self-recovery, the vast majority of ecological niches across the full range of environmental conditions are occupied by evolutionarily co-adapted, native (indigenous) species, including rare ones. By densely filling the ecological space, these species prevent the establishment of invasive (adventive) species within the biogeocenosis. At the same time, rare native species of plants and animals play a "buffering" role, occupying portions of ecological space that become available when dominant species experience fluctuations in their populations. Thus, an indicator of the capacity of ecosystems for self-recovery—as a natural factor of ecological balance stability—can be the nativeness of biodiversity, that is, the richness of indigenous species.

On the other hand, rare species of flora and fauna are the first to disappear from ecosystems under conditions of more significant disturbance, which makes them useful indicators for assessing the state of natural communities.

Analysis

At present, comprehensive measures are being systematically implemented in the Republic to establish a network of protected natural areas aimed at conserving unique natural complexes, preserving the genetic diversity of flora and fauna, preventing anthropogenic pressure on the environment, and supporting the study of natural processes, environmental monitoring, and ecological education and awareness among the younger generation. New categories of protected natural areas have been established, including state biosphere reserves and комплексные (ландшафтные) заказники, which contribute to the conservation and restoration of landscapes, plant and animal species—including rare and endangered species listed in the Red Data Book of the Republic of Uzbekistan—as well as other natural objects and complexes. These measures also support the improvement of environmental conditions and the rational use of natural resources.

In accordance with Presidential Resolution No. PP-4247 dated March 20, 2019, “On measures to improve the system of public administration in the field of protected natural areas,” and the Resolution of the Cabinet of Ministers No. 707 dated November 11, 2020, “On the establishment of the South Ustyurt National Nature Park,” a national nature park named “South Ustyurt” was created. According to this resolution, in order to improve ecosystem conditions within the park, and to conserve and restore unique species of plants and animals, the South Ustyurt National Nature Park was established with a total area of 1,447,443 hectares in the Kungrad district of the Republic of Karakalpakstan.

Findings and Discussion

The National Nature Park functions as a structural unit of the State Committee for Ecology and Environmental Protection of the Republic of Uzbekistan and holds special significance in terms of nature conservation, environmental education, and recreation, as a unique natural complex characterized by rich biodiversity of flora and fauna.

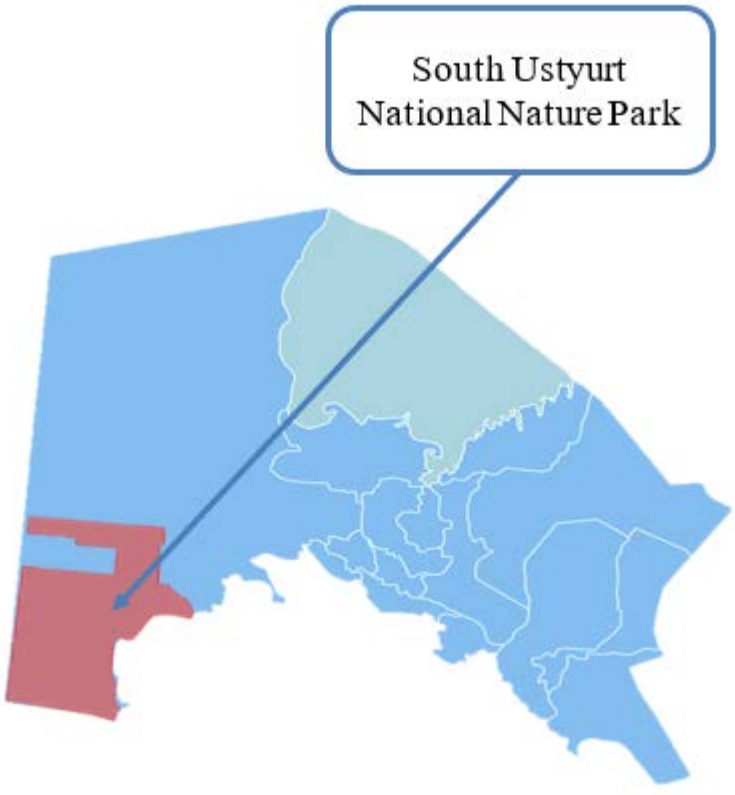

Fig. 1. Schematic map of the location of the South Ustyurt Protected Natural Area

The South Ustyurt region is characterized by a gently undulating plain, locally disrupted by smooth wave-like slopes and wide depressions (solonchaks and takyrs). The soil cover consists of brown soils with varying degrees of salinity, gradually transitioning into sierozem soils, accompanied by a corresponding distribution of vegetation. According to scientific data, 426 plant species belonging to 41 families and 225 genera have been recorded in this area. Dominant (edificatory) species such as biyurgun, boyalysh, keyreuk, and wormwood occupy vast territories.

Researchers and specialists also note that the clay-desert plains with wormwood–saltwort vegetation, which cover extensive areas of the plateau, are inhabited by 35 species of mammals, many of which are common. Rodents constitute nearly half of the mammalian species composition. In some areas, there is a high population density of comb gerbils, midday gerbils, and the yellow ground squirrel. A relatively poor but distinctive fauna characterizes Solonchaks, deep depressions, and takyrs. A total of 19 mammal species inhabit these environments, although the population size of most species remains low.

The principal threats to the biodiversity of the Ustyurt Plateau include the reduction and fragmentation of habitats, disruption of migration routes, unsustainable use of pastures, and intensified industrial development—such as exploration and extraction of natural gas, and the construction of railways and paved roads.

Under these conditions, the study of structural changes in terrestrial vertebrate communities and the impact of techno genic factors on biodiversity acquires significant scientific, theoretical, and practical importance. The decline in population numbers of rare species and their disappearance from occupied biotopes generally occur at relatively early stages of ecosystem degradation, when such changes are still reversible and many functional properties of natural communities have not yet been entirely lost.

Conclusion

Therefore, in the South Ustyurt region, less degraded areas still remain, which are of considerable interest for the establishment of protected natural areas—both for the conservation of rare species and, in particular, for the preservation of biome-forming species. The protection of such territories represents an important and necessary task.
The unfavourable status of rare species of flora and fauna can serve as an early indicator for diagnosing disturbances in ecological balance.

Thus, based on scientific and innovative technologies that enable ecological monitoring of animal migration routes and wintering sites, it is considered necessary to utilize newly established protected natural areas as research bases for training young specialists and for the further development of ecotourism.

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Artistic Psychologism in Franz Kafka's 'The Metamorphosis'

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Abstract

This article discusses the significance of artistic psychologism in "The Metamorphosis" by the prominent representative of world literature, Franz Kafka. It analyses how different forms of artistic psychologism—such as psychological description, psychological portrait, stream of consciousness, inner monologue, and dialogue—are used to reveal the inner world of a human being. Particular attention is given to the ways in which the author employs artistic psychologism to раскрыть the character of the protagonist, Gregor Samsa. These elements are highly valued as essential tools that contribute to uncovering the ideological content and deeper meaning of the work.

Keywords: Artistic Psychologism, Psychological Depiction, Psychological Expression, Psychological Portrait, Stream of Consciousness

Introduction

As a major representative of twentieth-century world literature, the works of Franz Kafka are widely recognized for combining elements of realism and fantasy. His writings typically depict absurd or surreal situations, as well as isolated protagonists confronted with incomprehensible social and bureaucratic forces. Franz Kafka, a German-speaking Jewish-Czech writer who occupies a prominent place in world literature, was born on July 3, 1883, in Prague, then part of the Austro-Hungarian Empire. He studied law and, after completing his legal education, worked in various legal and insurance institutions. His professional responsibilities led to inner conflicts, as he realized that his true vocation and talent lay in writing. However, his father did not understand his inner aspirations and directed him toward a career in law.

During the writer's lifetime, only a small portion of his works was published. He wrote hundreds of letters to his family and close friends, particularly to his father, with whom he maintained tense and formal relations. At the time of Kafka's death, his works were likely known only within a limited circle of Czech and German writers. Kafka left explicit instructions to his friend and literary associate Max Brod to destroy all his published and unpublished works after his death. He wrote: "Dear Max, my final request is that everything I leave behind… diaries, manuscripts, and letters—should be burned unread."

However, Brod disregarded this request and, between 1925 and 1935, collected and published Kafka's works, including his novels. As Kafka's close friend, Max Brod played a decisive role in preserving and publishing his literary legacy. As a result, Kafka's name

became known throughout the world, and his works left a profound mark on world literature due to their distinctive psychological depth. Today, a separate field of study known as “Kafka studies” has emerged in world literature. Moreover, the term “Kafkaesque” is now widely used in German and other languages, referring to situations that are disturbing, incomprehensible, absurd, or surreal in nature.

Review of Related Literature

The study of Franz Kafka’s works, particularly The Metamorphosis, has been enriched by both global and local scholarship. Saidov (2023), in his introduction to the Uzbek edition of The Metamorphosis, characterizes Kafka as “the genius of a mad world,” emphasizing the psychological depth and surreal qualities that define his literary style. This perspective situates Kafka within the broader tradition of twentieth-century modernist literature, while also highlighting his relevance to contemporary readers.

Hutchinson and Waters’ learning-centered approach to literature teaching finds resonance in Uzbek scholarship as well. Mirqosimova and Rustamova (2007), in Genre and Mastery, explore the artistic and structural dimensions of literary works, providing a framework for analyzing Kafka is blending of realism and fantasy. Similarly, To’ychiyev (2011) discusses the criteria of artistic expression in Uzbek literature, offering principles that can be applied to the study of Kafka’s narrative techniques and symbolic structures. Yuldashev (1996) contributes to the pedagogical dimension by outlining the scientific and theoretical foundations of teaching literature, underscoring the importance of integrating world classics like Kafka into national curricula.

The publication of Kafka’s works in Uzbekistan, such as the 2023 edition of The Metamorphosis by “Yangi asr avlodi,” reflects the growing interest in world literature and its adaptation into local educational contexts. This aligns with broader efforts to connect Uzbek literary scholarship with international standards and perspectives. By combining theoretical insights on genre, pedagogy, and artistic criteria with direct engagement with Kafka’s texts, the literature demonstrates a comprehensive approach to understanding his enduring influence.

Overall, the reviewed works highlight the dual trajectory of Kafka studies: global recognition of his unique literary style and local scholarly efforts to contextualize his writings within Uzbek literary and educational frameworks. This convergence underscores the importance of Kafka studies not only as a field of literary analysis but also as a pedagogical tool for fostering critical engagement with world literature.

Objectives

This study aims to examine the literary significance of Franz Kafka as a major representative of twentieth-century world literature, focusing on the unique blend of realism and fantasy in his works. By analyzing his depiction of absurd and surreal situations, as well as isolated protagonists confronting incomprehensible social and bureaucratic forces, the research seeks to highlight the psychological depth and thematic originality that define Kafka’s contribution to modern literature.

Another objective is to explore the role of Max Brod in preserving and publishing Kafka’s legacy. Despite Kafka’s explicit request to destroy his manuscripts, Brod’s decision to publish them between 1925 and 1935 ensured that Kafka’s works reached a global audience. This act not only secured Kafka’s place in literary history but also gave rise to

“Kafka studies” as a distinct academic field and the widespread use of the term “Kafkaesque” to describe disturbing, surreal, or incomprehensible situations.

Finally, the study intends to assess the broader impact of Kafka’s writings on world literature and cultural discourse. By tracing the evolution of his reception from limited recognition during his lifetime to worldwide acclaim after his death, the research underscores how Kafka’s works continue to shape literary analysis, philosophical inquiry, and cultural imagination. This objective highlights the enduring relevance of Kafka’s oeuvre in understanding the complexities of modern existence and the human condition.

Methodology

A considerable number of scholarly studies have been conducted on the life and creative work of Franz Kafka, and numerous films have been produced and theatrical performances staged based on his works. The renowned German writer Hermann Hesse, who was highly regarded in his time and considered worthy of the Nobel Prize, described Kafka as “a hidden force of German prose.” As a talented writer with a distinctive creative style, Kafka has been highly evaluated by literary scholars worldwide. For example, Harold Bloom noted: “At his best, Kafka competes with Dante and stands as the dominant Western author of our era.” Professor Harry Steinhauer stated: “Kafka has had a stronger influence on educated society than any other writer of the twentieth century.” Sandbank observed that despite Kafka’s widespread recognition, his unique style remains inimitable.

In Kafka’s works, through exaggerated and symbolic representations of events, the tragic vulnerability of human beings in the face of ignorance and cruelty is vividly depicted from a psychological perspective. Concepts such as law and humanity, light and darkness are presented in a state of ambiguity, with no clear path to escape from this condition. Although his works often portray themes of darkness, fear, emptiness, and uncertainty, the primary aim is not to instill fear in the reader, but rather to strengthen the individual’s belief in overcoming all obstacles. In general, faith in the human being, in the human soul and spirituality, forms the foundation of Kafka’s творчество. These ideas are also reflected in the portrayal of the characters discussed below:

- The Metamorphosis (Die Verwandlung): a short story about the traveling salesman Gregor Samsa, who is transformed into an insect;
- The Trial (Der Prozess): a novel centered on Josef K., who is prosecuted without knowing the nature of his accusation;
- The Castle (Das Schloss): a novel about a land surveyor who arrives in a village but is unable to gain access to the castle;
- The Burrow (Der Bau): a short story depicting the inner struggle of a protagonist who constructs an underground dwelling to ensure his safety;
- A Country Doctor (Ein Landarzt): a short story about a doctor left in a remote rural setting.

In addition to the works mentioned above, Franz Kafka produced many other literary works. However, this study primarily focuses on his well-known and widely analysed work “The Metamorphosis” (Die Verwandlung), which has been extensively examined by scholars of world literature. First published in 1915, “The Metamorphosis” is one of Kafka’s most famous works and consists of three parts.

The narrative centres on the experiences of the main character, the traveling salesman Gregor Samsa, who awakens to find himself inexplicably transformed into a giant insect. He struggles to adapt to this condition or to escape from it, while his family members gradually begin to treat him as a useless and burdensome individual. Gregor is portrayed as a person deeply devoted to his work; however, his transformation enables him to see those around him more clearly, leading to the painful realization that he is insignificant in the eyes of society and even within his own family. This awareness, combined with his helplessness, leaves a profound impact on his consciousness.

His dedication to supporting his family through his work, as well as his concern for helping his sister Grete develop her talents, reveals him as a character who lives for others and rarely thinks of himself, lacking a personal sense of purpose.

What kind of work is "The Metamorphosis"?

Analysis

"The Metamorphosis" is a profound and meaningful work that symbolically depicts the alienation and devaluation of an individual within society, characterized by strong elements of modernism and absurdism. From a psychological perspective, the work portrays the protagonist's inner suffering, fear, and loneliness. From a philosophical standpoint, it compels the reader to reflect on the meaning and value of human life, as well as the individual's place in society.

As can be seen from the discussion above, the story skillfully presents the psychological world of the individual. Uzbek literary scholars have expressed the following views on this work. Khurshid Dustmuhammad asks: "Why did "The Metamorphosis" become such a remarkable phenomenon in the history of world short stories? What allowed it to elevate narrative mastery to a new level? Most importantly, Franz Kafka approached the transformation of a human into an animal not as a fairy tale, legend, or fantasy, but as a real event. Without hesitation, he introduced this situation into the form of a realistic narrative as if it were an actual occurrence."

Professor Q. Yoldashev notes that Franz Kafka's творчество established a unique direction in world literature. In particular, "The Metamorphosis" serves as a clear example of this. He emphasizes that Kafka departed from traditional literary approaches and adopted a new mode of thinking. His works often lack a definitive resolution, because life itself has no conclusion; the world exists, people exist, and life continues.

Academician A. Saidov states that Kafka's "The Metamorphosis" is an exceptionally valuable work and a vivid example of existentialism in literature. Existentialism (from the French "existence") is one of the major philosophical movements of twentieth-century Western thought, focusing on individuality, human existence, and the irrational aspects of life. The prominent representative of this movement, Jean-Paul Sartre, described existentialism as "a humanism." Regarding "The Metamorphosis", the scholar further emphasizes that the work is not merely about a fantastical or surreal transformation of a human into an insect; rather, it is about the transformation of people themselves—how individuals lose their humanity and become something else. In simple terms, it reflects how people ultimately fail to understand one another.

“The Metamorphosis” is a work of profound emotional depth that portrays tragic loneliness and the sorrowful, devastating outcome of relationships even among the closest people. It is like a frightening dream from which one cannot awaken. In this story, Franz Kafka profoundly reveals the catastrophe of people failing to understand one another, becoming emotionally distant, and losing the ability to comprehend each other’s inner worlds. The transformation of a human into an insect serves as a distinctive artistic device used to depict how individuals—even those closest to one another—become like entirely different beings, incapable of mutual understanding. What deeply unsettles the reader in this work is not merely the lack of communication in language among family members, but rather their inability to understand each other’s hearts and emotions.

Many scholars have offered high praise for this work, considering it one of the most refined realistic forms of the short story genre in epic literature. Kafka’s portrayal of a human transforming into an insect is presented not as a fairy tale, legend, or purely fantastical depiction, but as a realistic event. This approach reflects important stages in the development of existentialism, modernism, and absurd elements in literature. Therefore, in examining the issue of artistic psychologism in this story, we proceed by presenting the following theoretical considerations in order to reveal the deeper meaning of the narrative.

Findings and Discussion

One of the primary functions of literature is to depict the human soul, its spiritual world, and inner experiences. Since human spirituality is highly complex, multifaceted, and often contradictory, its representation in literary works requires the use of specific artistic techniques. In this context, the concept of artistic psychologism emerges in literature. In general, artistic psychologism refers to the use of literary means to deeply portray an individual’s inner experiences, internal struggles, transformations of character, and spiritual states. It also represents the writer’s skill in analyzing and artistically depicting the psychological depth of characters—their emotions, inner monologues, and the dynamics of their feelings. Thus, artistic psychologism serves as one of the most important tools in literature for revealing the inner world of characters, their hidden emotions, internal conflicts, spiritual transformations, and psychological suffering.

In revealing the essence of artistic psychologism, two aspects are of primary importance: first, the consideration of the psychological state of characters in real life; and second, the process of constructing these psychological states through the author’s artistic creativity. In literature, artistic psychologism manifests in several forms. In analyzing Franz Kafka’s “The Metamorphosis”, it becomes evident that the writer employs various techniques of artistic psychologism. One such form is psychological depiction or psychological representation, through which the author vividly portrays the characters’ emotional states, such as fear, joy, anger, sorrow, doubt, and hope. In “The Metamorphosis”, this technique is clearly reflected in the protagonist’s feelings of fear, despair, and fragile hope. The central idea of the story revolves around the fear of becoming unnecessary. Gregor, who was once emotionally burdened yet human, becomes outwardly repulsive after his transformation, provoking feelings of rejection and disapproval not only in society but also even within his own family. Through the image of Gregor as an insect, Kafka powerfully conveys the experience of becoming unwanted.

Previously, Gregor had been the main support of his family—a hardworking and responsible individual who paid off debts and devoted himself to his household. However,

in a single day, he becomes a burden to his loved ones. At first, his family fears him; later, they begin to reject him, neglect him, deprive him of food, and eventually wish for his disappearance. For example, in the story, Gregor's sister Grete is overcome with fear when she encounters him. This fear is vividly expressed in the following psychological depiction: "Early in the morning—when it was still almost night—Gregor's sister, already fully dressed, cautiously opened the door and peered into his room, as if testing the firmness of the decision she had just made. She sensed Gregor at once, but seeing that he was under the sofa, she thought: 'Oh God, surely he couldn't have flown away—he must be somewhere!' She became so frightened that, unable to control herself, she quickly withdrew and locked the door from the outside…" In addition, the technique of the psychological portrait is employed in literary works to depict the characteristics of characters in connection with their inner states. In this approach, the characters' facial expressions, gaze, actions, external appearance, and their relationship with their inner condition are portrayed in an integrated manner. In "The Metamorphosis", the method of psychological portrait is illustrated in episodes involving Gregor's sister and mother:

"One day, nearly a month had passed since Gregor's transformation, and his sister was no longer surprised by his appearance. She entered earlier than usual and saw Gregor standing motionless in a frightening posture in front of the mirror. If she had not entered the room, this situation might have seemed ordinary to Gregor; however, as he stood before the mirror, he was blocking his sister from opening the window. She did not step into the room, but immediately recoiled, stepped back, and locked the door. To an outsider, it might have appeared as if Gregor were deliberately blocking his sister and was about to attack her. Of course, Gregor at once hid himself under the sofa. Yet he had to wait until evening for his sister to return, and when she did, there was a certain unexplainable anxiety in her…"

A similar example of a psychological portrait is presented in the episode where Gregor's mother sees his appearance:
"—What shall we take out now?" said Grete, glancing around anxiously. At that moment, her gaze met Gregor's eyes as he clung to the wall. Since her mother was beside her, Grete restrained herself and, in order to prevent her from turning around, stepped closer and, trembling, uttered the first words that came to her lips:
—Shall we go back to the living room for a moment?

Grete's intention was clear to Gregor—she wanted to take her mother to a safe place and then drive him down from the wall. Let her try! He remained sitting on the picture and would not give it up; if necessary, he was ready to throw himself at Grete's face. Yet Grete's words alarmed her mother; she stepped aside and noticed large dark spots on the patterned wallpaper. Before realizing that it was Gregor hanging on the wall, she screamed at the top of her voice: "Oh God, oh God!" Then, with her arms outstretched and powerless, she collapsed onto the sofa and lay motionless.
"Gregor!" cried his sister, raising her fist and glaring at him.
These were the first words addressed directly to Gregor after his transformation into an insect."

In modernist literature, the technique of stream of consciousness—one of the widely used forms of artistic psychologism—depicts a character's thoughts in a disordered and rapidly shifting manner. This technique frequently appears in the works of Franz Kafka. For

example, it is vividly illustrated in Gregor's psychological state when the manager from his workplace arrives at his home:
"Gregor, speaking hurriedly and scarcely understanding his own words, muttered incoherently. He moved closer to the chest in his room and, leaning against it, tried to raise his entire body upright. He truly wanted to open the door, to leave his room, and to speak with the manager; he was eager to see what those waiting outside would say upon seeing him. If they were frightened, then Gregor would be relieved of his responsibility and could feel at ease. If they accepted it calmly, then there would be no reason for concern, and if he hurried, he could indeed be at the station by eight o'clock. At first, he slipped several times from the polished chest, but finally, with one last movement, he managed to stand upright. He paid no attention to the pain in the lower part of his body, though it was causing him great suffering. Now he felt capable of controlling his body and remained silent, listening for the manager's response…"

In the stream of consciousness presented above, the author portrays Gregor's inner experiences in such a way that he imagines the thoughts of those around him as if they were his own. Although Gregor tries to justify and explain himself, the inability of others to understand him gives rise to feelings of fear, hopelessness, and loneliness, gradually extinguishing his inner spirit.

In literary works, a character's self-reflection and inner thoughts are expressed through the technique of inner monologue, which is an important form of artistic psychologism. This method allows the author to reveal the most hidden layers of a character's inner world. Franz Kafka skillfully employs inner monologue in his work. For example, Gregor engages in a self-reflective dialogue about his profession:
"Oh God," he thought, "What a demanding profession I have chosen! Traveling day in and day out. The worries of business are far greater than those at the office, and on top of that, there is the strain of constant travel, anxiety about train connections, irregular and poor meals, and the fleeting, superficial relationships with ever-changing, unfamiliar people. To hell with it all! …"

In addition, in this work, dialogue also plays an important artistic role in revealing the psychological experiences of characters other than Gregor. For example, when Gregor's mother faints upon seeing his insect-like appearance, the following dialogue between his father and sister is presented:
"—What has happened?" These were his first words. Grete's appearance revealed everything to him. Hiding her face in her father's chest, she replied in a trembling voice:
—Mother has fainted, but she is recovering now. Gregor has come out.
—I expected this," said his father. "I have always warned you about it, but you women never listen…"

Seeing his wife and daughter terrified of Gregor and perceiving his transformation as a burden upon the family, the father becomes enraged. He takes apples from a bowl in his pocket and throws them at Gregor, wishing for his disappearance. One of the apples strikes Gregor forcefully in the back, leaving him severely injured. Confronted with his father's furious behavior, Gregor is left stunned. The wound caused by the apple weakens him, and ultimately contributes to his death.

Conclusion

The protagonist of the story, Gregor, who is transformed into an insect, remains lonely throughout his life. Even before his transformation, he did not share warm and affectionate relationships with his parents and sister, as his thoughts were entirely consumed by his work responsibilities. The climax of the narrative is clearly expressed through Gregor's death. He dies alone in his room. When the housemaid informs his family of his death, they show no strong emotional reaction; they do not even grieve. On the contrary, they seem relieved by Gregor's passing. Turning their attention to their daughter's future, they leave the house for a walk, as if freed from a heavy burden. Franz Kafka does not explain the reason for the protagonist's transformation into an insect, leaving its interpretation to the reader. From this work, the following conclusion may be drawn: if a person is of no benefit to others, they risk becoming unnecessary. Living as someone who is deemed unnecessary destroys the individual's inner world and forces them to endure profound psychological suffering. Therefore, people who are capable of understanding one another and who inspire compassion and trust in the human heart are of great importance.

In this work, Kafka does not merely portray feelings of loneliness and worthlessness, but also seeks to emphasize that compassion and humanity should not disappear from people's hearts. In general, the impact of any literary work is largely determined by the credibility and depth of the psychological experiences of its characters. Thus, artistic psychologism serves as one of the most important tools in literature: it is a fundamental means of developing the plot, revealing conflict, and creating character, while also deepening the ideological content of the work. As demonstrated in the analysis above, artistic psychologism vividly portrays the protagonist's inner world, his experiences of isolation, and the complex psychological emotions that overwhelm his soul through expressive and nuanced psychological depiction.

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Methodology of Gathering, Selecting, and Processing Factual Materials: A Foundation of Journalist's Professional Competence in the Information Age

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Abstract

This article examines the theoretical and practical significance of facts in journalistic practice, highlighting their central role in ensuring accuracy, credibility, and public trust. It explores the key functions of facts in journalism, including informing the public, supporting objectivity, shaping narratives, and holding institutions accountable. In an era marked by misinformation and rapid digital communication, the study emphasizes that fact-based journalism remains essential for maintaining ethical standards and promoting an informed society. As part of the research process, the study also investigates the perspectives of media professionals on the use of facts in journalistic work. To achieve this, a specially designed open-ended survey consisting of 20 questions titled “The Role of Facts in Journalistic Work and the Skill of Using Facts” was conducted. The responses were analysed to identify common practices, challenges, and levels of professional competence in fact usage. The findings reveal that while journalists recognize the importance of factual accuracy, they often face pressures related to speed, competition, and information verification. The article concludes that strengthening fact-based reporting requires continuous professional development, adherence to ethical guidelines, and institutional support to ensure responsible and high-quality journalism.

Keywords: Fact, Fake, Fact-Checking, Infodemic, Journalism, Media Literacy, Pandemic

Introduction

In today's globalized and information-saturated world, the role of journalism in society is invaluable. In the context of unlimited information flows, the rapid development of social networks, and the widespread dissemination of fake news, the importance of fact-based journalism is growing even more. The main task of journalism is to provide society with reliable, objective, and truthful information. Facts play a central role in effectively fulfilling this task.

Therefore, journalists should pay attention to the significance of facts in the creative process.

Review of Related Literature

The literature on journalism and media studies highlights the growing complexity of professional ethics, media literacy, and the challenges posed by misinformation. Uchenova (2009) examined the epistemological dimensions of journalism, emphasizing the role of publicistic discourse in shaping political and social narratives. This theoretical

foundation underscores the importance of understanding journalism not only as a profession but also as a cultural and intellectual practice.

Muradova, Grizzle, and Mirzakhmedova (2019) contributed to the discourse on media and information literacy, stressing its necessity in contemporary journalism education. Their work aligns with Ernazarov's (2002) exploration of reporting theory and practice, which provides practical insights into the skills required for effective journalistic activity. The publication Qaraqalpaqstan Jaslari (2018) further illustrates the regional context of journalism, reflecting the socio-political environment in which journalists operate.

Recent scholarship has increasingly focused on the phenomenon of the "infodemic." Muratova (2020) and Alimov (2021) highlighted the dangers of misinformation during the pandemic, noting that disinformation can be more harmful than the health crisis itself. Raspopova and Bogdan (2018) analysed fake news and information mystification, offering a framework for understanding how misinformation undermines public trust. Complementing this, reports on ethical journalism in Europe (jrnlst.ru) discuss the crisis of credibility and the ongoing struggle against fake news, situating the issue within a broader international context.

Taken together, these studies reveal a dual trajectory in journalism research the theoretical exploration of publicistic and ethical dimensions, and the practical challenges of combating misinformation in the digital age. The literature underscores the urgent need for strengthening ethical journalism and enhancing media literacy to safeguard both professional integrity and public trust in contemporary media ecosystems.

Objectives

In today's globalized and information-saturated environment, journalism plays a critical role in safeguarding truth and ensuring that societies are informed with reliable and objective content. The rapid expansion of social networks and the proliferation of fake news have intensified the demand for fact-based reporting. Within this context, the study emphasizes that the central responsibility of journalism is to provide truthful information, positioning facts as the cornerstone of journalistic integrity and credibility.

The analysis highlights the necessity for journalists to prioritize factual accuracy in their creative processes. Facts are not merely elements of reporting but serve as the foundation upon which trust between media and society is built. By focusing on the significance of facts, journalists can counter misinformation, strengthen public confidence, and uphold the ethical standards of their profession.

Ultimately, the findings suggest that reinforcing fact-based journalism is essential for navigating the challenges of modern information flows. Journalists must cultivate practices that integrate factual rigor into their work, ensuring that their contributions remain relevant, ethical, and impactful in an era where truth is often contested. This approach not only enhances the credibility of journalism but also supports the broader goal of fostering an informed and resilient society.

Methodology

For this reason, within the framework of the study, a special open survey was conducted on "The Role of Facts in Journalistic Work and the Skill of Using Facts," consisting of 20 questions, to study the opinions of media professionals on this issue. More than 200

respondents participated in this survey, including editors of republican, local, and industry newspapers, journalists from local television and radio channels, skilled publicists, and young journalists from the Republic of Karakalpakstan. During the research, the creative processes of experienced journalists were studied, direct interviews about their activities were conducted, a series of journalistic materials published in the media was collected, and the skills of using facts were analysed and applied in the practical part of the work.

Analysis

Below, we present an analysis of the survey results. In particular, to the question "What is a fact? What is the role and significance of facts in a journalist's work?" almost all participants confirmed the opinions of theorists. Among them are original ideas integrated with practice. We will cite some of them. (The following and subsequent sections reflect the participants' responses to the questions).

"Facts play a crucial role in a journalist's work. If the facts are weak, the resulting material will also be weak."

"Facts are the primary source that brings to life any work written in a journalistic genre."

"Facts are a means of substantiating opinions. Stated opinions and conclusions are supported by facts. Facts make a journalist's work easier."

"Facts form the foundation of an article. If the facts cited in an article are unclear, its value diminishes. In this context, facts serve as the main criterion," and so on. Now, let us analyse the answers to the question, "What should a journalist focus on more when gathering facts? Is there a specific methodology for obtaining facts?" "Refer to Table 1":

Table 1.

Existence of methodology	**Lack of methodology**
Methodology is finding the core of a fact. For example, one should accept a fact that carries the same meaning in three out of five sources;	There is no set methodology. Depending on the topic of the article you are writing, you collect facts. Whether through observations or interviews, ultimately - this is where skill comes into play;
There are various methodologies. This depends on the journalist's skill. To obtain facts, a person must be knowledgeable, activate their knowledge, and act as a psychologist during conversations.	"When gathering facts, you focus on the direction of the article you're writing. There is no fixed methodology for obtaining facts.

As can be seen, 50% of journalists say there is a methodology for obtaining facts in response to this question, while the other half emphasize that there is no precise measure and that it depends on the journalist's skill. In our opinion, such a methodology is necessary. This methodology stems from the journalist's scientific approach to and analysis of the event.

Interestingly, 65% of respondents answered "not necessary" to the question "Does a journalist have to confirm every opinion with facts?" "See Diagram 1":

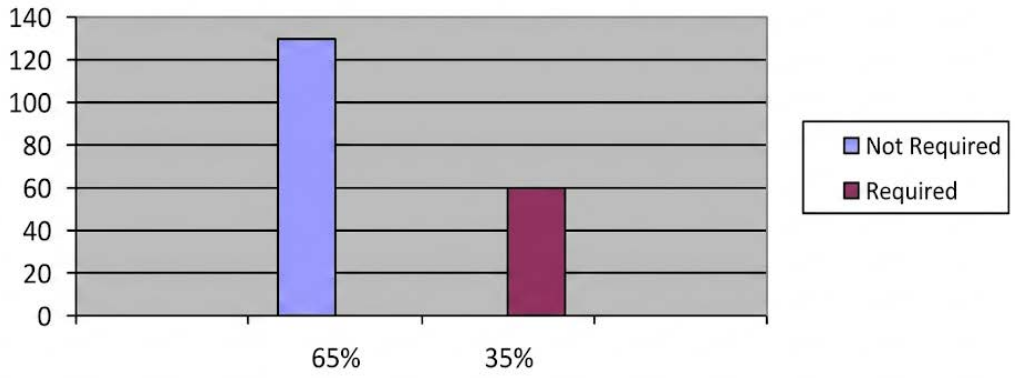


Diagram1

We will present some of their responses. We won't dwell on the "Necessary" answer. Respondents explain why it is not necessarily required: For example, "It's not necessary. It depends on the writer's reflection. They can confirm or cancel it." Another states, "It depends on the situation at that time. Some things do need confirmation. If an opinion might mislead people, then it must be verified. Because there are various axioms." Additionally, "It's a mistake to think that an article based solely on facts will be strong. It depends on the topic. If it's a chronicle-based theme, then facts are needed. In such cases, hearsay is inappropriate. Facts support your opinions." Another journalist approached the use of facts from a creative standpoint: "It's not necessary to confirm everything. It's appropriate to use facts in the main idea you want to express. Facts can be presented more beautifully with artistic touches. If only facts are used throughout, the reader will get bored." Thus, from the creators' opinions, it can be understood that their "not necessary" doesn't mean facts are unnecessary, but rather implies that facts should be used where appropriate.

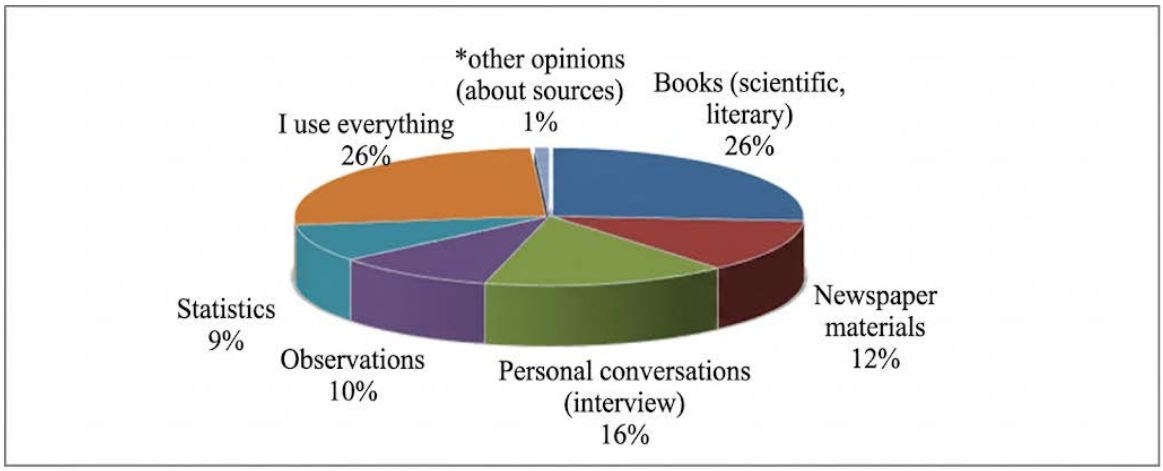
Accuracy plays a central role in determining the media's influence in society. If listeners and viewers don't trust the media as a means of accurately conveying facts, it indicates that journalists have failed even in their most basic task. Because "the primary requirement for a journalist is to guarantee that people receive accurate and truthful information by reflecting objective reality." Accuracy in facts means not only the correctness of verifiable facts (names, place names, birth dates, and quotes) but also the need for an impartial, fair approach to the viewpoints presented in the article. In this regard, in a survey conducted as part of the research, the renowned publicist Urazboy Abdirakhmonov noted: "a fact cannot be creative material in itself. The writer's attitude towards the fact and the process is important."

Analysis shows that recently, the majority of materials published in newspapers belong to the news or reportage genre. Articles on the same topic often resemble twins, being very similar to each other. This is due to the inability to distinguish the unique aspects of the presented facts. For example, the newspaper "Qaraqalpaqstan jaslari" published a report under the heading "Weddings are linking to weddings" about wedding and circumcision ceremonies held for children from socially vulnerable, low-income families

as part of charity events in Qonliko'l, Amudaryo, and Qorao'zak districts. In all three materials, the facts, their arrangement, and interpretation are practically identical in both content and form. In this case, a journalistic approach and research are not evident.

Distinguishing between documentary information and facts obtained from reliable sources, and applying such information in one's own material requires special research, knowledge, and critical thinking from the creator. It is known that sources of facts are divided into several types: witnesses (those who saw the event with their own eyes), documents, real processes (observation), and others.

In the conducted survey, let us consider the respondents' answers to the question "In your opinion, which sources provide more reliable facts? Which sources do you rely on more when writing an article?"



*Note. One of the participants stated that none of the sources we cited were reliable.

"In journalism, a fact is characterized by truth and its expression. In turn, the concept of a journalist's 'objectivity' is closely linked to the notion of 'documentaries.' This serves as a guarantee of the journalist's independence and objectivity. When covering any story, a journalist should rely on documented facts; that is, the subject matter should be confirmed either directly or through additional evidence". The essence of working with documents lies entirely in verifying their reliability and authenticity. If the authenticity of a document is questionable, the original text should be obtained from the author and subjected to special analysis. This analysis enables the determination of the document's structural aspects, authenticity, or other characteristics. Sometimes, even with these methods, it can be very difficult to ascertain the authenticity of the source; in such cases, it is advisable to consult experienced specialists with a deep understanding of the field. Additionally, participants provided various answers to the question, "Is it necessary to confirm the obtained information with other sources? If so, what approach would you take?" We will discuss some of these responses below (refer to Table 2).

Table 2

Must be verified by another source	**No need to verify with other sources**
Of course, verification is necessary. Some people may provide false information. Facts need to be checked. This is because people read newspapers today. For example, if we claim that 15	This will be revealed during the analysis process. It is advisable to compare the suspected information.

kindergartens have been built in the district and their construction has been completed, residents of that area will know that two of them are not yet fully finished. Therefore, it's essential to verify the accuracy before writing;	
The obtained fact must be verified by its manifestation in real life and its final outcome. If necessary, it should be crosschecked and compared with other sources.	Verified facts may not always be truthful. The power of the pen lies in the art of persuasion;
A journalist must exercise extreme caution when using any fact. It is beneficial to thoroughly examine it and corroborate it with other sources.	A newspaper journalist does not have time to compare a obtained fact with information from another source. In some cases, when I encounter such a need for comparison, I often turn to a specialist in the relevant field;

In particular, one of the survey participants emphasizes, "If a fact is not precise, confirmed, and verified, using it in an article discredits the author and causes doubt in the audience." This observation is correct in every aspect.

Presenting information to the audience based on at least two reliable sources eliminates potential problems that may arise later. Sometimes, for legal reasons, issues of confidentiality, or similar concerns, it is not recommended to specify the sources. In such cases, it is necessary to ensure that the source is reliable. This is because, first, "the reader or listener is interested in the source of the information". If a journalist does not cite the source of information, it creates the impression that the information belongs solely to the journalist. The audience evaluates the value of information based on the reliability and credibility of the message source". To ensure authenticity, journalists must first determine the sources of facts, understand the informant's intentions, and distinguish between scientific and everyday facts.

Scientific fact-based materials are regularly published in the press. Scientific facts are always based on numerous empirical observations, experiments, and trials. When preparing analytical materials, journalists primarily rely on scientific facts. Using scientific facts is very convenient, as the main characteristic of all scientific evidence is its accuracy and reliability. Therefore, journalists frequently refer to this in their materials. For example, the article "Suw-tirishilik deregi" [Water is the Source of Life] by Professor Sarigul Bahadirova, a member of the Creative Union of Journalists of Uzbekistan, uses facts, opinions, and conclusions that are scientific, socio-politically and economically justified, and most importantly, reflect our national values, which encourages reading the material with interest. The facts are clearly stated in simple, accessible language. Below is an excerpt from the article: "The Aral Sea is a sea formed in the middle of the Kyzyl-Kum Desert. It is a sea that has existed for many centuries, created by God's power in the middle of a desert that amazes mankind..."

Along with scientific facts, journalists effectively utilize various types of everyday facts from our surroundings in their materials. Such facts provide an opportunity to discuss people's direct experiences, their approaches to ongoing events, and other related aspects. Additionally, journalists employ the traditional method of presenting materials through statistical data during their work. Numbers are an optimal way to reveal the essence of a problem by describing a specific phenomenon, showing the dynamics of an event's development, and ultimately drawing conclusions based on them.

Findings and Discussion

The unprecedented integration of the internet into our lives has led to a sharp increase in the number of sources disseminating social information. This, in turn, is contributing to a reduction in the reliability of information or an increase in its uncertainty. Researchers note that alongside the COVID-19 pandemic, another pseudo-pandemic has emerged worldwide. It has been termed "infodemia". Currently, fake content is observed not only in breaking news and social networks but sometimes also in serious official media. We can see this in the example of fake news. Such messages closely resemble reality, and there are various methods for their dissemination. One of the most dangerous global problems is precisely false news and the resulting damages. In this regard, the most effective solution to the problem, that is, in combating fake news, is fact checking. It is no secret that the increasing demand for information from the audience has led to the development of practices for verifying the reliability of disseminated information and refuting it if its objectivity is not confirmed. In other words, it has accelerated the process of fact verification.

"In the 21st century, several innovations have been introduced to the field of journalism. In particular, fact checking - the process of verifying information - has begun in the scientific sphere. In the first decade of this period, separate departments were established in non-governmental non-profit organizations or quality media editorial offices that professionally verify facts. Their emergence is associated with a number of complex reasons".

Maxim Kornev, Associate Professor of the Russian State University for the Humanities and Director of the "Journalist" portal, lists the following 5 methods for verifying information:

1. provide information from several independent sources or provide confirmation;
2. ask opposing parties;
3. learn to recognize fake content;
4. the accuracy of evidence is more important than sensationalism;
5. use social networks with caution.

"The Washington Post" operates in this regard. Unfortunately, they are primarily targeted at English-speaking audiences.

"Previously, the media was the foundation of information production and journalism. Now everything is different: technological, economic, and political transformations have changed the media. The demand for verified reports has increased, and this has begun to require high skill from journalists. In particular, with the growing phenomenon of "fake news" in journalism, the demand for specialized journalists has increased due to the prevalence of inaccurate information not based on concrete facts. In the modern political climate, the focus is on various events, specific individuals, and economic debates. In the fight against fake news, a journalist's ethics plays a special role".

As is known, the entire world is currently battling the COVID-19 coronavirus pandemic. In such a dangerous situation, it has become very easy to influence people's minds and persuade them. This has led to an increase in fake news. Naturally, in these circumstances, the media and journalists have been entrusted with an even more important and responsible task than ever before: urging people not only to avoid becoming victims of the virus but also to remain vigilant against misinformation. The reason for this is that "the crisis in journalism is currently intensifying due to disruptions in the media space caused by incidents of propaganda, fake information, pranking, digital aggression, trolling, and etc. ‘Information overload ‘is leading to’ information ambiguity Manipulation of consciousness through these means is resulting in the increased 'swallowing' of any information worldwide, due to the audience's lack of 'critical autonomy'.

According to a study commissioned by Internews, the results of a social survey conducted for the first time by the Public Opinion Research Institute in July 2019 showed that at that time, most respondents were unaware of the concept of "fake news." However, at the next stage of the study, the result was different, indicating that the flood of information caused by the coronavirus had taught the majority of the population what to believe. Having examined the complex nature of facts and their purpose in journalistic work, it is important to acknowledge that achieving objectivity in covering events is difficult if a journalist does not use only carefully verified, reliable information. This can be understood from the opinions of survey participants and their work experience.

The prevalence of fake news depends, on the one hand, on the professionalism of journalists, and on the other hand, on the media literacy of information consumers. It is noteworthy that in the context of the pandemic, the sharp increase in fake news is developing readers' skills in properly handling information. This includes determining which sources are reliable and fact-based, or which news is true. As a result, the number of people with a high level of media literacy is currently growing worldwide. This, of course, represents an important change and growth in all respects.

Conclusion

In today's fast-paced information age, a journalist's primary tool and responsibility is adherence to facts. At a time when disinformation and fake news are widespread, journalists must rely on verified and reliable information in every piece of their work. This not only strengthens the journalist's reputation but also ensures that society has a conscious understanding of reality. Fact-based journalism helps citizens make informed decisions and enhances the transparency of democratic processes. Thus, facts are not only an integral part of a journalist's work but also a key indicator of their service to society.

As emphasized in the article, facts are not merely information for a journalist, but the foundation and ethical criterion of their professional activity.

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Innovative ESP Strategies for Agricultural Specialists

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Abstract

This research explores the methodological frameworks for improving English for Specific Purposes instruction within the agricultural higher education system of Uzbekistan. In light of the "Uzbekistan-2030" strategy and recent presidential decrees, the study emphasizes the transition to a credit-module system and the integration of innovative pedagogical approaches such as CLIL (Content and Language Integrated Learning), EMI (English as a Medium of Instruction), and EOP (English for Occupational Purposes). The paper analyses the necessity of developing professional communicative competence among agricultural specialists to ensure their global competitiveness. The results indicate that utilizing task-based and situational learning methods significantly enhances students' ability to process professional information, such as technical patents and specialized literature, thereby bridging the gap between academic theory and practical agricultural application.

Keywords: Credit-Module System, CLIL, EMI, ESP (English for Specific Purposes), Professional Communicative Competence

Introduction

In recent years, fundamental reforms and changes have been taking place in all sectors of our country's national economy. In particular, elevating the fields of science and education to a higher level based on innovative pedagogical ideas, in order to join the ranks of the world's developed nations, has become a primary issue of our time. The most effective action in this direction begins with increasing the number of qualified personnel who have mastered a foreign language, possessed modern knowledge, and think creatively. By introducing advanced methods of foreign language teaching that, utilize modern information and communication technologies into the education sector, a number of tasks are being defined and implemented. These aim to create broad opportunities for the growing younger generation to effectively use the achievements of world civilization and vast information resources, and to develop international partnerships and the exchange of ideas.

In line with this effort, based on the Presidential Decree PQ-1875 of December 10, 2012, "On Measures to Further Improve the System of Learning Foreign Languages," practical initiatives have accelerated. These initiatives focus on organizing the continuous teaching of foreign languages at all levels of the education system, as well as improving teacher qualifications and the provision of modern educational and methodological materials. Furthermore, as a continuation of the reforms initiated in the field, the adoption of the Presidential Decree No. PQ-5117 of May 19, 2021, "On Measures to Raise the Work of Popularizing the Study of Foreign Languages in the Republic of Uzbekistan to a

Qualitatively New Level" has guided efforts toward positive results. This decree aims to further improve the quality of foreign language teaching as an important direction of educational policy, attract knowledgeable and experienced educators to the field, and increase the public's interest in learning foreign languages.

To systematize the popularization and improvement of foreign language instruction in our country, raise young people to be well-rounded individuals, and support and strengthen the oversight of creating all necessary conditions for this, the Cabinet of Ministers of the Republic of Uzbekistan adopted Resolution No. 34 on January 19, 2022, titled "On Additional Measures for Improving Foreign Language Learning" Based on this resolution, the issue of developing and implementing information and communication technologies and software projects in foreign language teaching was brought to the forefront. This includes creating video clips, games, creative presentations, films, and other educational content to promote the in-depth mastery of foreign languages and develop fundamental language skills. In accordance with the decree "On the Uzbekistan-2030 Strategy" by the President of our country, Sh.M. Mirziyoyev, dated September 11, 2023, "Creative Parks" will be established in each region to help young people acquire modern professions. These parks will engage at least 40,000 young people annually, and school graduates will have the opportunity to master at least two foreign languages and one profession. Building on this, the abilities of at least 2 million young people will be developed by enhancing their intellectual potential, encouraging their scientific activities, and fostering their interest in scientific and innovative work, intellectual games, and foreign language learning. Most significantly, 500 talented young people will be sent to study at prestigious foreign higher education institutions each year at the expense of the state budget.

The essence of all adopted normative-legal acts embodies the interests of the individual, especially the goal of enabling young people to engage with the world. In this direction, a number of tasks have been defined, and comprehensive measures are being implemented to create a unified system of international relations in the field of education, encompassing both international and national markets. Examples include international projects such as CLIL (Content and Language Integrated Learning), collaboration between English language teachers and other subject teachers, and the introduction of educational forms like EMI (English as a Medium of Instruction) and STEM (Science, Technology, Engineering, and Math). To disseminate these projects more widely and taking into account the importance of language proficiency, we must refer to European standards in higher education, as indicated in the Bologna Declaration.

Although the Republic of Uzbekistan has not joined the Bologna Process as a full member state, it is undertaking gradual work in several of its areas. On this basis, the orientation of higher education institutions towards integration into the European Higher Education Area has intensified the focus on creating variable programs for all subjects, including foreign languages. Specifically, in accordance with the "Concept for the Development of the Higher Education System of the Republic of Uzbekistan until 2030," approved by the Decree of the President of the Republic of Uzbekistan on October 8, 2019, it is planned for 85% of the country's Higher Education Institutions (HEIs) to gradually transition to a credit-module system by 2030. It is envisioned that these HEIs will primarily introduce the ECTS credit-module system.

Review of Related Literature

Research on English for Specific Purposes (ESP) has evolved significantly over the past decades, with foundational contributions from Hutchinson and Waters (1987, 1993), who emphasized a learning-centred approach, and Dudley-Evans and St. John (1998), who highlighted ESP's multidisciplinary nature. Basturkmen (2010) further advanced course design principles, stressing the importance of aligning language instruction with learners' professional and academic needs. These works collectively underscore the centrality of learner motivation, contextual relevance, and pedagogical innovation in ESP development.

Motivation and learner attitudes have been identified as critical factors in ESP success. Humoud (2010) explored Saudi university learners' perspectives, revealing the importance of social and cultural contexts in shaping engagement. Slesarenko (2007) emphasized interdisciplinary goal setting in technical universities, while Tukhtasinov and Kholiyorov (2019) examined compensatory competence formation among agricultural students, highlighting the role of professional terminology in bridging linguistic gaps. These studies illustrate the necessity of tailoring ESP instruction to specific learner groups and professional domains.

In Uzbekistan, reforms in foreign language education have been guided by key legislative acts, including Presidential Decrees PQ-1875 (2012), PQ-5117 (2021), and the Cabinet of Ministers Resolution No. 34 (2022). These initiatives aim to improve teacher qualifications, integrate modern technologies, and promote innovative methods such as CLIL and EMI. Nuratdinova (2023) and Kubeysinova (2023) examined the application of CLIL and EMI in agricultural education, demonstrating their potential to enhance subject-specific language competence. The Bologna Declaration (1999) and Uzbekistan's gradual alignment with the European Higher Education Area further emphasize the importance of adopting international standards, including the credit-module system (Kun.uz, 2020).

Overall, the literature highlights a dual trajectory: global theoretical and methodological advances in ESP and localized reforms in Uzbekistan aimed at integrating international practices into national education. This convergence underscores the need for systematic approaches that combine pedagogical innovation, motivational strategies, and policy-driven reforms to strengthen ESP instruction and align it with both national priorities and global standards.

Objectives

This study aims to analyse the ongoing reforms in the field of foreign language education in Uzbekistan, focusing on how innovative pedagogical approaches and modern information and communication technologies are being integrated into the national education system. By examining legislative initiatives such as Presidential Decrees PQ-1875 (2012), PQ-5117 (2021), and the Cabinet of Ministers Resolution No. 34 (2022), the research seeks to evaluate the effectiveness of these measures in expanding opportunities for young learners, improving teacher qualifications, and fostering international collaboration.

Another objective is to assess the role of strategic programs like the "Uzbekistan-2030 Strategy" in shaping the future of education, particularly through initiatives such as the

establishment of Creative Parks, the promotion of multilingual proficiency, and the support for talented youth to study abroad. The study intends to highlight how these reforms contribute to raising a generation of well-rounded individuals equipped with foreign language skills, scientific knowledge, and creative thinking abilities.

Finally, the research aims to explore the alignment of Uzbekistan's higher education system with European standards, including the gradual transition to the ECTS credit-module system and the adoption of international projects such as CLIL, EMI, and STEM. By analyzing these developments, the study seeks to provide insights into how foreign language learning reforms not only enhance academic quality but also strengthen Uzbekistan's integration into the global educational community.

Methodology

This system began to be applied during the process of obtaining international accreditation for the higher education programs of Uzbekistan's HEIs, as well as within the framework of implementing bilateral cooperation agreements with foreign higher education institutions. In this regard, students of the Karakalpakstan Institute of Agriculture and Agro technologies have been given the opportunity to study for a period of 3-6 months, specifically the first semester, in Kazakhstan, Russia, Japan, and a number of European countries during the 2024-2025 academic year, based on academic mobility and the Erasmus+ program. In particular, an agreement with the JD-EAST company has created opportunities for short-term, three-month paid internships at advanced agricultural enterprises in Germany. Based on the agreement, 100 students were sent for internships in 2024, and it is planned to send 200 students by the end of 2025. Additionally, graduates of the institute's bachelor's programs have the opportunity to study at the master's level on a grant basis at foreign higher education institutions that have cooperation agreements.

Extensive cooperation is being carried out between various countries of the world in the economic, cultural, educational, political, and agricultural sectors. Agriculture is considered one of the most important economic sectors worldwide, and special attention is being paid to production, joint projects, solving problems in the agrarian sector, crop cultivation, and improving the English language skills of specialists in the agricultural field. Therefore, in specialized agricultural programs, professionally-oriented English language teaching has further intensified the need to develop professional communication and communicative competence, as well as to learn the relevant vocabulary (agro-terms). In agricultural specializations, conducting scientific research on results-based English language teaching, the practical application of knowledge, improving skills through exercises that develop professional communication and competence, professional development, and enhancing communicative competence is of great importance.

In global foreign language teaching practices, scholars have utilized various approaches for teaching English for Specific Purposes (ESP). These include teaching methods based on different interactions, such as Content and Language Integrated Learning (CLIL), where students learn content and a foreign language simultaneously in an integrated manner. Other methods focus on developing specialized lexical skills in students, such as English-Medium Instruction (EMI), task-based learning, language-based learning, content-based learning, and project-based learning. English language training programs like English for Occupational Purposes (EOP) and English for Academic Purposes (EAP) are of great importance. This demonstrates the relevance of studying international best

practices and conducting scientific research on the development of professional communication. From this perspective, one of the key issues today is to further increase the importance of teaching foreign languages, particularly English, for training competitive personnel in the field, enabling them to master the rich experience of developed countries and strengthen partnerships.

Teaching a foreign language in a non-philological educational context, specifically oriented towards professional and field-specific purposes, has now become an object of specialized research. By the 1960s, a number of scientific studies on teaching English for specific purposes had been conducted, and new teaching methods were developed. Today, specialists are researching the teaching of English in higher educational institutions specializing in agriculture from a new perspective. One of these methods is the creation of a curriculum based on a professionally-oriented model of personal socio-cultural formation. The components of the English language teaching process include "communicativeness, intercultural competence, professional knowledge, professional communication, and professional language". Modular training programs have been developed to enable students to discuss information, make creative decisions, and achieve a high level of cultural maturity. In other words, efforts are being made to create and use universal multimedia textbooks for language learning for specific purposes. Educational programs aimed at improving the quality of foreign language teaching through mass media, especially the internet, will also be launched. Nevertheless, the issue of enhancing professional competence, one of the main goals of foreign language learning, has not been sufficiently explored as a research object.

Currently, along with developments in all social and economic sectors, the demand for learning English in agriculture is growing. However, there are some obstacles to the use of English in agriculture. According to foreign scholars, "translators do not pay attention to the target needs and knowledge levels of students in the agricultural field, which leads to misunderstandings during the teaching process". English for Specific Purposes, including its instruction for students specializing in agriculture, has become increasingly important in recent years. English for Specific Purposes courses not only aim to thoroughly prepare students for their future professional activities but also envision their development as globally recognized personnel. According to J.J. Jalolov, a prominent scholar in English language teaching methodology: "The selection, distribution, methodological classification, and presentation of foreign language material are carried out by program developers and textbook authors. The student and the teacher participate and work together in the process of studying/teaching the educational material".

As I.M. Tuxtasinov notes: "Forming students' interest in learning a foreign language, developing their ability and knowledge to work with dictionaries, definitions, and primary texts, systematizing necessary grammatical materials, correctly understanding professional texts, and developing artistic translation skills are the demands of today". In H. Basturkmen's view: "A needs analysis in teaching English for specific purposes determines the language and skills used in students' target profession or work and study environments according to their current situation, practical capabilities, and limitations" The scholar divides the types of academic and field-specific English language teaching into general and specific groups. This opinion is quite well founded and can be represented in the following table (Table 1.):

Table 1. H. Basturkmen's Approaches to Teaching Academic and Specific-Purpose English.

Branch	Sub branches	Example
English for Academic purposes (EAP)	English for General Academic Purposes (EGAP)	English for Academic Writing
	English for Specific Academic Purposes (ESAP)	English for Law studies
	English for General Occupational Purposes (EGOP)	English for hospitality industry
English for Specific Occupational Purposes (ESOP)	English for Specific Occupational Purposes (ESOP)	English for hotel receptionists

Analysis

As we can see, each field is divided into groups for teaching English for general and specific purposes. According to foreign methodologists and linguists, professional communication is the ability to communicate effectively within a specific professional field. This includes lexical, grammatical, and pragmatic competencies. It encompasses not only the exchange of verbal information but also processes such as establishing connections, solving problems, consulting, and making decisions. Regarding the concept of professional communication and its application in teaching, the views of foreign scholars T. Hutchinson and A. Waters can be noted. According to their theory, "professional communication is the ability to use language effectively in authentic professional situations (i.e., the ability to practically apply language in real professional contexts). They advocate for an educational approach that considers the needs of each student and aligns the educational process more closely with real professional situations.

In today's interconnected world, agriculture is closely linked with international information, technologies, and markets. Consequently, students studying in this field must not only have a good command of English but also possess professional communication competencies specific to agriculture. The systematic, gradual, and continuous development of these skills is essential. To develop professional communication skills, it is necessary to understand the content of materials dedicated to specific communication areas and contexts from real life. For students in the agricultural field, it is crucial to teach functions such as using vocabulary related to their specialty, obtaining information, asking questions, and preparing reports. For instance, this includes texts and exercises based on real-life agricultural situations like water supply, crop cultivation, animal husbandry, and agribusiness.

Some scholars believe that colleges and universities are not obligated to teach all students the general English used in everyday life or the workplace. Instead, it is argued that students should only learn the specialized English used in particular academic subjects or specific professions. However, how well students understand and use English depends on their reasons for learning it. Furthermore, the importance of proficiency in professional communication and writing has not been sufficiently established. Due to the inadequate English proficiency of first-year students in most non-philological higher education

programs in our republic, teaching a specialized academic or professional language poses considerable difficulties. In this context, teaching English for general professional and academic purposes creates an opportunity to both enhance students' language proficiency levels and prepare them for instruction in specialized academic and professional language. English for General Academic Purposes is the teaching of English for all specializations, which primarily entails developing academic skills, namely grammar and language proficiency, in accordance with scientific methodology. It has been shown that teaching English for Professional-Specific Purposes is more appropriate than teaching English for General Academic Purposes.

According to the foreign scholar B. Humoud, a significant difference has been demonstrated between the specifics of teaching and learning English in the context of vocational education. In such cases, the teaching process must be completely different, as students studying English for Specific Purposes are required to have specific knowledge related to their professional field.

Based on the ideas above, the differences between teaching general English and teaching English for Specific Purposes are divided into distinct groups (Table 2).

Table 2 Distinctive Features of Teaching English for General and Specific Purposes

The Specifics of Teaching General English	**Teaching English for Specific Purposes**
• Not being tied to a specific field; • Language learners are of various ages; • Diversity of objectives; • Long-term nature of the education; • Not originating from the language learner's specific demands; • Not being oriented towards professional or industry-specific topics; • The majority of language learners are at the beginner level; • The vocabulary is diverse, and grammar is taught systematically; • Utilization of all types of speech activities; • Greater focus on teaching forms of socio-cultural communication.	• Connection to a specialized subject; • The majority of language learners are adults; • Unity of purpose in language learning; • Taught within a short or fixed timeframe; • The necessity of learning English is taken into consideration; • Selection of topics oriented towards a specific field; • Language learners' proficiency level is intermediate or advanced; • The presence of specialized vocabulary and terminology; • Teaching of specialized grammar; • Focus on socio-cultural and professional communication; • Learners possess high motivation.

It is becoming increasingly clear that the quality of foreign language teaching is a key factor in the effectiveness of students' integration and adaptation into foreign higher education institutions and the professional labour market, as well as in the exchange of information and innovations in the field of agricultural science.

Findings and Discussion

The transition to a multi-level model of higher vocational education, while preserving the traditional system of training future specialists, necessitates that the content of foreign language teaching in agricultural higher education institutions be updated. This update should be based on scientific research dedicated to developing professional communication, practical information exchange, and professional communication competencies in accordance with the current state educational standard. A communicative approach implies that the process of teaching a foreign language at a higher educational institution specializing in agriculture must consider and integrate the structure of speech activity in that language and prepare the future specialist for specific professional activities. This includes developing professional skills related to information retrieval, such as reviewing, selecting, sorting, and comparing journal and newspaper articles, books, patents, advertisements, and catalogues with existing information.

Professionally oriented learning also includes a number of requirements, the most typical of which for an agronomist (a specialist in the field of agriculture) are: searching for factual material, familiarizing oneself with this material, and processing new information. Thus, reading is considered a vital form of speech activity, as specialists working in the agricultural sector use the internet to learn about agricultural equipment and tools. To understand the specifics of using agricultural equipment and innovative technologies, the ability to read instructions, supplementary explanations, and texts is required. During their professional careers, reading serves as a tool for meeting students' personal and professional needs. From a professionally-oriented perspective on organizing foreign language instruction at an agricultural university, we can say that learning a foreign language at a university represents a new stage. Students' acquisition of professional communicative ability in a foreign language - comprising their linguistic knowledge, speaking skills, communicative aptitude, and personal qualities - fosters a culture of business and professional interaction in their collaborations. The goal of teaching a foreign language, specifically English, in agricultural universities is the practical mastery of the language by students, in accordance with the requirements of the State Educational Standard for Higher Professional Education. Students must acquire a communicative competence that enables them to use the foreign language in their professional activities and for the purpose of self-education.

For many years, professionally oriented foreign language teaching has been one of the central subjects of methodological research in both domestic and international scholarship. The "English for Occupational Purposes" (EOP) aspect of the "Sector-Oriented Foreign Language" course introduces terminology that is thematically relevant to the fundamentals of a given specialization. Based on this terminology, the following are implemented: teaching listening comprehension of academic speech; developing basic oral communication skills (using materials from the specialization); developing skills in reading specialized literature to obtain professional information; familiarizing students with relevant daily publications in this language (international, national, sectoral, and abstract journals); familiarizing students with sectoral dictionaries and reference materials in this foreign language; teaching students the essential writing skills needed to master the vocabulary and phraseology that reflect the main directions of broad and narrow specializations, prepare theses, and exchange information; familiarizing students with the functional and stylistic heterogeneity of academic speech; and familiarizing students with the fundamentals of abstracting, annotating, and translating specialized literature. In accordance with the program, developing the skills to abstract, annotate, and

translate professionally oriented literature serves, firstly, as a source of information and, secondly, is considered the foundation of professional communication.

However, to determine whether the content of vocationally oriented foreign language teaching in a higher education institution specializing in agriculture is accounted for in modern programs, it is necessary to examine the phenomenon of professional communication among specialists in a foreign language. It has been determined that this is a complex and goal-oriented process of interaction in which several individuals solve production-related tasks within the scope of their professional activities by influencing each other's intellect, positions, behaviour, and feelings. This process takes place under specific social and psychological conditions, namely within certain spheres and potential situations of professional communication in a foreign language. The field of communication, serving as an extra linguistic background, reflects the specifics of the interlocutors' activities, influencing both their speech actions and their choice of linguistic tools. It should also be noted that in the spheres of communication, professional conversation occurs in various situations and is determined by a number of “determinants” of speech behavior, namely, goals, topics, and the nature of the interlocutors. These determinants affect foreign language interactions, specifically the form and content of speech products - texts - in which language serves as a means of communication. Of course, the implementation of these functions is impossible without students possessing the necessary linguistic and worldly knowledge, as well as relevant skills. Furthermore, for successful professional communication, it is essential for students to have the communicative and intellectual skills that ensure the effectiveness of communication.

Thus, taking into account the specifics of professional communication in a foreign language, the curriculum for teaching a foreign language at a higher educational institution with an agricultural focus should include the following components: specific fields, situations, and topics of communication; texts; language and speech knowledge; interpersonal skills; intercultural competence; as well as terms and specialized communication methods widely used in professional activities. This aligns with the principles of ESP (English for Specific Purposes), which necessitates language teaching based on the learners’ needs. Specifically, language learning within the framework of EOP (English for Occupational Purposes) should encompass authentic situations, communicative roles, and lexical units necessary for professional activity. Such an approach is based on communicativeness and places the goals, context, and tasks of communication at the centre of language teaching. Students learn not only the language system (grammar, phonetics, vocabulary) but also how to apply it in a professional context. From this perspective, methods such as “task-based learning” (TBL) and “situational learning” (SL) are particularly effective, as they provide opportunities to use the language in a practical context.

In the current era of globalization, students who acquire professional communication skills in a foreign language, especially English, are enabled to become competitive specialists in the international labour market. This research work has thoroughly examined the methodology for effectively teaching the elements of professional communication in English to students in the field of agricultural education. The study analysed the theoretical and methodological foundations of teaching professional communication in English, curricula designed for students in agricultural education, as well as modern interactive methods used in teaching (role-playing, debates, case studies,

and others). The results of practical experience have shown that these methods develop not only students' language skills but also their abilities for systematic thinking, critical reflection, teamwork, and clear expression of their thoughts. The findings of this research will be useful for improving the quality of foreign language teaching in agricultural higher education institutions, for the targeted and systematic training of students in professional communication, and for creating materials that can serve as a methodological and practical guide for instructors. The research contributes to a modern-day re-evaluation of language teaching strategies within the agricultural education system to meet contemporary demands.

Conclusion

The findings of this research, alongside the analysis of current educational reforms, lead to several key conclusions for the improvement of foreign language teaching within the agricultural sector. Primarily, systemic integration proves that the quality of foreign language instruction is a decisive factor in ensuring students' effective adaptation into the global professional labour market and the international exchange of agricultural innovations. This necessitates a significant methodological shift; transitioning to a multi-level model of higher vocational education requires a comprehensive update of ESP (English for Specific Purposes) course content. Rather than focusing solely on general language proficiency, the curriculum must prioritize professional skills such as advanced information retrieval, including the ability to review and analyse patents, catalogues, and specialized journals.

Furthermore, the ultimate goal of teaching English in agricultural universities must transition toward the practical mastery of communicative competence, enabling future specialists to utilize the language for both their professional duties and continuous self-education. The study demonstrates that integrating effective frameworks—such as English for Occupational Purposes (EOP), Content and Language Integrated Learning (CLIL), and Task-Based Learning (TBL)—creates an authentic educational environment essential for mastering specialized agro-terminology. Ultimately, the strategic impact of these interactive methods extends beyond linguistics, as practical experience shows they foster systematic thinking, critical reflection, and teamwork. These findings serve as both a methodological and practical guide for instructors, ensuring that agricultural education meets contemporary global demands.

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The Influence of Visual Design in Social Media on the Branding of Makerspaces

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Abstract

Visual design components such as colour, typography, and images are crucial to a successful brand identity because social media has drastically changed branding tactics and visual interaction. Chinese makerspaces are depending more on social media to foster creativity and community involvement, but little is known about how visual design influences their branding. Henceforth, the current research study has the goal of examining the association between visual design and social media, considering a precise mediating role on the branding of makerspaces. The present research employed a cross-sectional, quantitative study design to gather data. Simple random sampling was utilised in this study to select 649 supporters from social media makerspaces in Guangdong Province, China. Survey questionnaires were employed to collect data. Additionally, the researcher conducted an Analysis of Variance (ANOVA) to identify the significant connection between the research variables and descriptive analysis to examine the fundamental patterns of the data. The findings identified that visual design materials significantly influenced social media platforms from the perspective of the branding effectiveness of makerspaces. These results suggested that visual communication techniques in making social media posts played a role in enhancing brand recognition, audience engagement, and credibility. According to the conclusions of the study, it is essential to understand the effects of visual communication to promote efficiency in the entire operation of makerspaces in Guangdong Province, China. Moreover, the consistent use of visual aspects, including colour, typography, images, and layout, helped increase brand recognition and, consequently, affected the efficiency of the makerspace.

Keywords: Branding of Makerspaces, Social Media, Visual Design, Visual Communication

Introduction

The extremely continuous evolution of digital technological approaches has completely changed the way businesses interact and preserve their identities in the current digital world. In this evolving context, digital media has evolved into a significant medium for interacting with users and sharing information. It promotes the development of brands. Visual design has a big influence on audience perceptions and is a crucial component of social media communication. In addition, it affects a unified company identity. Makerspaces are cooperative settings that foster invention, creativity, and hands-on learning. The purposeful use of graphic design in social media has become more well-known for boosting branding efforts and increasing exposure. A makerspace is a place where people who are interested in technology may work together on projects and

exchange information and ideas. Even though the public sector has shown a great deal of interest in makerspaces and is confident in its contribution to the innovation ecosystem (Radu & Schneider, 2023).

Makerspaces are communal settings where people work together to create using digital fabrication equipment and community-driven learning initiatives. These areas have become well-known around the world as inspiration for innovation and business. It often promotes skill development and multidisciplinary cooperation. However, makerspaces are depending more on digital channels to create their identity and visibility outside of their physical locations. Previous studies emphasised that social media shapes initial views and affects participant access while acting as a gateway to makerspaces. This showed that it is extremely vital for makerspaces to express themselves visually in the virtual spaces (Jongmans et al., 2022). Another research also evaluating makerspace online postings and transparency has a significant influence on the way prospective users see these places. The way makerspaces are portrayed on social media shows that digital content promotes diversity and audience engagement over time, in addition to reflecting the ideals and activities of these spaces. Branding outcomes depend heavily on the visual and communication strategies used on virtual media platforms (Himawati et al., 2025).

The influence of user engagement and information processing highlights the visual design in social media. Visual features can expand the clarity of information and draw our emotional responses. It promotes reinforcing brand awareness and loyalty with memorability. Creativity and innovation are critical in makerspaces. The social media posts which are aesthetically pleasing and strategically crafted can improve a unique corporate identity and distinguish one makerspace from another makerspace (Zakoth et al., 2024).

Review of Related Literature

In current research on the digital era, the function of visual design as a variable in technology and digital interaction is important. Online users who depend on visual design to understand visualised algorithms and their interactions inside digital environments are all facilitated and mediated by the branding of makerspaces (Akahome, 2026). Prior research has investigated the impact of visual interaction design elegance on enhancing customer purchasing behaviour on digital media. The research demonstrated the impact of colour typography and images on consumer impressions and purchasing decisions. The prior research also emphasised that consumer attention and trust in items have developed by aesthetically pleasing and well-structured designs (Chan et al., 2023). On the other hand, the research of Sugiyarto (2025) elaborated that visual quality improved brand image, thereby fostering purchasing intentions. Furthermore, reliability in visual style across social media platforms enhanced brand awareness and credibility. The study determined that organisations adeptly implemented visual communication design concepts, which are more inclined to attract consumers and enhance their purchasing power in the competitive digital marketplace (Sugiyarto, 2025).

Another research by Tsai and Shyr (2022) examined the variables affecting visual perception reactions to video communication on virtual media sites. The study aimed to determine the way audiences perceived and responded to visual elements embedded in social media video content. This study revealed that visual clarity and colour composition substantially affected audience engagement and perception (Tsai & Shyr, 2022). However, Soomro et al. (2022) contended that well-organised and aesthetically pleasing

videos developed viewers' understanding and emotional reactions, while proficient visual communication improved message transmission and audience retention. The research mostly concentrated on the technical and aesthetic aspects of visual communication, with little discourse on cultural preferences. The study also demonstrated the enduring efficacy of visual tactics across various digital platforms. The study primarily focused on audience emotions, neglecting to critically analyse the way algorithmic exposure and platform-specific attributes may influence engagement levels. Notwithstanding these constraints, the research offered a significant paradigm for comprehending the way of visual design aspects affect audience perception and engagement in digital communication situations (Soomro et al., 2022).

Additionally, Melo and Rodney (2023) investigated the influence of first impressions on novice experiences in makerspaces and emphasised certain design features. The research examined the influence of layout labelling and ambient design on customers' understanding and willingness to engage. The research indicated that a straightforward and visually appealing interface was crucial for guiding new users and reducing confusion. The study revealed that positive first perceptions encouraged further involvement and exploration. The research determined that intentional visual design and effective signage communication are essential for enhancing user experience and strengthening the branding and functioning of makerspaces (Melo & Rodney, 2023). This research provided substantial insights into the way minor elements influence involvement in makerspaces. Research by Himawati et al. (2025) examined the incorporation of innovative design and visualised branding in digitalised marketing techniques to enhance brand consciousness and marketplace identification for micro and medium-sized enterprises. The study analysed the role of creative graphic content in fostering a strong brand identity across all digital platforms. The findings showed that innovative visual branding has the ability to enhance customer awareness and engagement. Moreover, the combination of branding and design can increase loyalty and trust among customers. Hence, the companies that use creative visual design in digital marketing seem to achieve better visibility and a unique market identity (Himawati et al., 2025).

Syntactic Theory by Lester (2006) of Visual Communication that clarified the way the arrangement of visual components, including colour, shape, size, and layout, influenced the meaning construction. The theory emphasised that audiences interpret pictures based on structural links and that effective design organisation improves clarity, concentration, and message transmission in visual media (Lester, 2006). Recent research has used the Syntactic Theory of Visual Communication. The previous study of Panayides and Xinaris (2024) demonstrated that poster designs communicated themes of conflict using visual elements like symbols, colour, and composition. The research evaluated that viewers perceived these visuals both emotionally and intellectually, with a structured design enhancing meaning and making complex themes of conflict more significant and understandable (Panayides & Xinaris, 2024). The Syntactic Theory of Visual Communication provides a relevant theoretical framework for understanding the way visual design elements in social media influence the branding of makerspaces by enhancing audience perception and facilitating effective brand messaging.

Objectives

To evaluate the effect of visual design on social media, considering the mediating role of the branding of makerspaces.

Methodology

Research Design and Procedure

This current research utilised a quantitative, cross-sectional research design to explore the influence of social media visual design on the branding of makerspaces in Guangdong Province, China. The approach facilitated the gathering of data from respondents at a specific time frame to quantify trends and examine the relationship between the research variables. Appropriate respondents received an online structured questionnaire designed to collect data. The survey instrument was created during the study procedure, utilising the research variables. Cronbach's Alpha was utilised for reliability assessment, while a pilot test was conducted to verify validity. The delivery of the questionnaire to the selected sample and statistical analysis utilising SPSS version 25 facilitated the identification of the interrelationship between visual design and social media, as mediated by branding of makerspaces. The extent and orientation of the statistical association were indicated within the confidence interval at 95%. The researcher established the statistical significance at $p < 0.05$. The researcher employed ANOVA for data assessment and utilised descriptive analysis to delineate the fundamental characteristics of the data.

Operational Framework

Subjects or Data Sources

A survey was conducted to collect primary data for the research. Supporters from social media makerspaces in Guangdong Province, China, provided data, as they had expertise in makerspace activities and online engagement. The survey comprised two sections: (a) demographic data of the respondents, and (b) statements evaluated on a 5-point Likert scale to assess the influence of visual design in social media on the branding of makerspaces.

Instrumentation and Data Analysis

The current study employed a simple random sample method to identify genuine and pertinent respondents within the research framework. The Raosoft tool suggested 620 research subjects for data gathering in the study. Consequently, 780 survey questionnaires were disseminated to the participants. Researchers received 725 completed questionnaires, of which 76 were eliminated due to incorrect or incomplete responses. Consequently, the final sample size was 649. Statistical analysis was conducted utilising Microsoft Excel and SPSS version 25 for the research study. The researcher employed the descriptive analysis method to understand the essential elements of the gathered data, while ANOVA was utilised to assess the collected data.

Limitations

The research into the influences of visual design components in digital media on the branding of makerspaces had several limitations inherent to quantitative research. The application of closed-ended survey questions prevented respondents from giving detailed answers, thus making it impossible to gather more complex responses regarding the context behind their perception of various visual design elements. The study focused on assessing

the effects of visual design elements on branding success. Nevertheless, the quantitative data used often simplified the difficult connection between visual design, audience engagement, and branding. Additionally, the data collected during research was only provided by supporters of makerspaces on social media in Guangdong Province, China. The use of such data raised some concerns regarding its validity since it was hard to generalise the findings obtained as the study was confined to one province. Cultural and technological differences made the findings less relevant for other parts of the country or abroad. The cross-sectional research design made it difficult to identify any cause-and-effect relations. The data obtained during the study could not show any dynamics of audience engagement and branding success.

Analysis

Factor Analysis

The goal of Factor Analysis (FA) is to discern previously unrecognised elements from observed variables. Regression coefficients are frequently employed in assessments when there are no discernible visual or diagnostic cues. The preliminary aim of the analysis is to determine any discernible correlations, susceptibility, or breaches. Kaiser-Mayer-Olkin (KMO) test datasets are obtained from various regression analyses. The findings indicate that both the theoretical model and its randomly chosen components produce dependable estimates. The possibility of identifying duplicate data entries is present. The data becomes clearer when the proportions are simplified. KMO provides a numerical value to the researcher, spanning from 0 to 1. The KMO value, between 0.8 and 1, signifies an appropriate sample size.

Kaiser has determined that the following sums are appropriate: Those that follow are the permission criteria according to Kaiser's recommendations:
An appalling 0.050 to 0.059, well below the usual range of 0.60 to 0.69. The typical range for middle grades is between 0.70 and 0.79.
A quality point score between 0.80 and 0.89. The interval from 0.90 to 1.00 astounds them.
Table 1: Examination of KMO and Bartlett's Sampling Adequacy
According to the Kaiser-Meyer-Olkin scale: 0.879
The results of Bartlett's test of Sphericity are as follows:
4853.245 is the approximate chi-square value
190 is degrees of freedom (df); sig = 0.000.

Table 1: KMO and Bartlett's Test

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		*0.879*
Bartlett's Test of Sphericity	Approx.Chi-Square	4853.245
	df	190
	Sig.	0.000

The researcher utilised Bartlett's Sphericity Test to evaluate statistical significance in the correlation matrices. A sample size was considered appropriate when the KMO score attained 0.879. Bartlett's Test of Sphericity produces a distinct p-value of 0.00. It was logical to deduce that the correlation matrix is not considered an identity matrix, given the favourable outcomes of Bartlett's Test of Sphericity.

Independent variable

Visual Design

This is essential in developing stories about their brands and ensures that the brands differentiate themselves from their competitors. Visual Design is defined as the arrangement of visual elements with the focus of delivering a message and evoking emotional responses. The creative elements of visual design are very helpful in marketing products to consumers. Social media plays an essential role in delivering a message to the intended audience. The application of visual design is broad within various disciplines such as graphic design, web design, advertising, and digital media. This is due to these disciplines play a major role in influencing perceptions and understanding of the information delivered to the audience (Jongmans et al., 2022). Therefore, visual design involves aesthetics and communication. The principles of balance, alignment, hierarchy, proportions, and consistency act as guides in capturing the viewers' attention and interpreting the message.

Mediating Variable

The Branding of Makerspaces

The idea of makerspaces has proliferated globally and is providing digital fabrication tools to a diverse audience in recent years. This phenomenon is referred to as the maker movement. It originated from the do-it-yourself and hacker cultures. Makerspaces are referred to as fablabs or hackerspaces. It is physical environments that provide access to communal fabrication gear, such as 3D printers, laser cutters, woodworking and metalworking facilities. Individuals utilising such facilities are referred to as makers. The maker community is defined by innovative methods within makerspaces. These include internal drive and a trial-and-error methodology (Zakoth et al., 2024). Makerspaces enhance a culture of sharing. Branding in makerspaces embraces components such as visual identity (logos, colour schemes, and design aesthetics), message, and narrative construction. These characteristics collectively articulate the makerspace's mission that emphasises education as well as creativity and technological innovation. The branding of makerspaces has enriched entrepreneurship. A clearly articulated brand enables consumers to comprehend the essence of the makerspace and its capacity to facilitate their educational or project development requirements. Moreover, branding is essential in influencing perceptions and enhancing engagement. Makerspaces may augment exposure and credibility through constant communication across digital platforms, social media, and real environments. Vigorous branding encourages collaboration by cultivating a sense of belonging and a collective purpose among users (Allen et al., 2023).

Dependent Variable

Social Media

Social media can be defined as the development of Web 2.0 applications, which were constructed to enhance transparent communication and interaction. Social networking sites are large online networks designed to help people communicate and exchange information online in the digital era. Social media platforms are becoming increasingly popular. It is both a mirror and a shaper of human consciousness. Social media is more than just digital channels meant for communication purposes. It is a culture-changing phenomenon which

has changed knowledge production and consumption. Social media usage has brought about huge changes in self-concept as well as organising movements and firms. Social media greatly affects public opinion. In many cases, it affects behaviour and helps disseminate information quickly. Social media allows people to communicate through text, pictures, videos, and interactivity. Social media impacts personal and professional communication in a significant way. In addition, social media has evolved into an essential tool for marketing and branding (Kanchan & Gaidhane, 2023).

Relationship between visual design and social media, considering the mediating role of the branding of makerspaces:

Visual design and social media have significant roles in making it easier to brand makerspaces. Visual design is the first contact of makerspaces with the people who follow them on social media channels. Well-versed visual design increases the beauty of aesthetics and ensures that the material gets attention in the highly competitive world of social media, where visuals play an important role. Good visual design makes it possible to develop a brand identity for makerspaces. They can create recognition and trust in their target audience by ensuring consistency in visuals across all articles and posts they share. Infographics, videos, and other visual content can be a substantial way to showcase projects in makerspaces and conduct workshops. Such a technique will help to make sure that all the data is both attractive and comprehensible. Not only will makerspaces help the audience understand the project, but they will also encourage people to interact and exchange ideas. Attractive pictures can become a source of high-quality design since social media algorithms prioritise them. Thus, this method will become an effective one in terms of increasing visibility and reaching the target audience. Makerspaces featuring attractive visual designs will have more chances to attract followers, partners, and stakeholders. Incorporating visuals into social media marketing strategy will result in successful branding and the creation of vibrant and innovative makerspaces online (March et al., 2022).

The researcher has developed a hypothesis to understand the relationship between visual design and social media, considering the mediating role of the branding of makerspaces, based on the preceding discourse:

"H_{01}: There is no significant relationship between visual design and social media, considering the mediating role of the branding of makerspaces."

"H_1: There is a significant relationship between visual design and social media, considering the mediating role of the branding of makerspaces."

Table 2: H_1 ANOVA Test

ANOVA					
SUM					
	Sum of Squares	**df**	**Mean Square**	**F**	**Sig**
Between groups	90,646.239	270	6070.129	1118.299	0.000
Within Groups	627.634	378	5.428		
Total	91,273.873	648			

The study had produced significant results. The F-value of 1118.299 and p-value < 0.05 established statistical significance of the data. Hence, the researcher accepted the alternative hypothesis, ***"H_1: There is a significant relationship between visual design and social media, considering the mediating role of the branding of makerspaces",*** and rejected the null hypothesis.

Findings and Discussion

The study examined the significant association among the research variables. The KMO value of 0.879 showed the sample adequacy. Moreover, Bartlett's Sphericity Test indicated the statistical significance of the correlation matrix, which indicated that it was suitable for FA. Additionally, the significant results from ANOVA exhibited statistical significance among the variables, which led the researchers to reject the null hypothesis. Hence, these results identified that visual design has a significant effect on social media, along with the mediating role of the branding of makerspaces. It became evident from the analysis that efficient visual design enhanced the identification of the brands. It improved the engagement and communication of the social media consumers to identify the associated impact of all the research variables.

The outcomes of the research showed that visual design had an effect on the branding of makerspaces via social media platforms. Such visual design components as colour, fonts, and images have been proven to increase the efficiency of communication strategies adopted by makerspaces. These aspects helped improve both the quality of messages delivered on social media and brand identity and consistency. It became clear that organised visual design could increase user engagement through improved aesthetics and message clarity. Users tended to have greater preferences for makerspaces which managed to maintain consistent visual aesthetics across all social media channels. Consistent visual design corresponded to better brand recognition and more positive attitudes of the audiences towards makerspaces. Thus, it became clear that visual design has a significant role in establishing the credibility of makerspaces. Well-designed, professional-looking social media profiles looked more credible and reputable to the target audience. From the findings, it is evident that there was a mediating role of branding between visual design and social media performance. Visual design was not an isolated practice; instead, its performance was improved when branding was applied together with the process. The findings demonstrated that excellent visual designs improved brand performance and increased the performance of communications in makerspaces on social media platforms.

Conclusion

The research concluded that visual design significantly enhanced the branding of makerspaces through social media channels. The appropriate use of colour and layout helped in creating a consistent brand image. The findings showed that well-organised visual content enhanced communication strategies by making the information more engaging for the audience. It demonstrated that consistency and visual design quality across all social media platforms strongly impacted the engagement of audience and brand awareness. Makerspaces that align with a consistent visual identity developed more positive perspectives and better customer relationships. The study found that professional and visually appealing designs enhanced the credibility and authenticity of makerspaces. Furthermore, the research demonstrated that the branding of makerspaces functioned as a mediating variable between visual design and the efficacy of social media. The impact of visual design was amplified when aligned with explicit branding efforts. The study indicated that the incorporation of strategic visual design principles enhanced the visibility and communication efficacy of makerspaces through consistent branding approaches in the contemporary digital landscape.

The results of the research offered various practical and theoretical implications for the managers of makerspaces, digital marketers and branding professionals. The results of this

study indicated that makerspaces gained advantages from using uniform visual communication tactics to enhance brand identification and increase audience engagement. The study also may indicate that the strategic use of colour, typography, layout, and imagery augmented the credibility and exposure of makerspaces on social media platforms. The research suggested that makerspace administrators and digital marketers must focus on attractively arranged material to attract followers and sustain robust online engagement. The study theoretically substantiated the significance of the Syntactic Theory of Visual Communication in elucidating the impact of organised visual elements on audience perception and branding results. The research may suggest that educational institutions and creative groups may use strategic visual branding strategies to foster creativity, collaboration, and community engagement through digital platforms.

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உலகளாவிய க விியி தமி ெசய களி ப களி

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Abstract

உலகளாவிய க விியி தமி ெமாழிைய ெகா ெச வதி , ல ெபய வாழ ய தமிழ க தா ெமாழிைய க பி பதி தமி ெசய க (Apps) இ மிக கிய ப கா கி றன. ல ெபய தமிழ களி அ த தைல ைற தமி ெமாழிைய ெகா ெச வத இ ெசய க பாலமாக அைமகி றன. சில ெசய க க ற எளிைமைய தி, ெமாழியறி . க வேதா க வி சா றித கைள ெப த கிற. மாணவ களி க திற ேக ப , ேவக தி ேக ப பாட தி ட ைத மா றியைம வசதிைய . ெசய க வழ கி வ கி றன. ெபாறியிய , அறிவிய , ம ேமலா ைம ேபா ற அறிவிய ைறசா பாட கைள ட தமி ெமாழியி ெமாழிெபய க ப ட காெணாளிக , ெசய க ல மாணவ க க க ஏ வாகிற . பிற ைறசா . ேபா ேத க தமிழி க த ெசய களா கிராம ற மாணவ க பய ளதாக அைமகி றன. ெச ெமாழி த தி ெப ற தமி ெமாழிைய உலெக தர ைறயாம ெகா ெச பணிகைள ெச ேவன. ெச வ வதி ெப ப கா கி றன. இ வா தமி ெசய க உலகளாவிய க விியி ெப ப கா றினா , ெதாழி ப ாீதியாக ெமாழி ாீதியாக சில. கியமான இைட கைள எதி ெகா கி றன. லபாட ேவ பா க , எ, தமி - ேப தமி ேவ பா க , இல கண பிைழக என சில இைட கைள ச தி க ேநாி கிற . ஆனா , கிராம ற ம வ ைம ற மாணவ களி ப ைற அறி ெப க, உலகளாவிய க வி தர ெபற வழிவ கிற இ தமி ெசய க .

Keywords: Slow Learners, 1C Schools, AI-Based Learning, Virtual Reality (VR)

Introduction

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க ெவ கால த இ ைறய கணினி ம ெசய ைக ணறி (AI) கால வைர, த ைன தகவைம ெகா உயி ட இ ஒ சில
ெமாழிகளி தமி த ைமயான . மிக பழைமயான ெமாழிகளி ஒ றாக , தனி த ைம ெப ற , ெதா ைமயான பல இல கிய கைள ெகா ட இ நிைலெப இ ெமாழி தமி . உலக தமி ேபச யவ க ஏற தாழ 8
ேகா ேமலாேனா உ ளன . இ ைணய தி , ெம ெபா உலகி தமி ெமாழி மிக ேவகமாக வள வ கிற . , ஆ பி ேபா ற னணி நி வன க தமி, தனி கிய வ அளி கி றன. ஆ ேபா , ஹா வ ேபா ற உலக க ெப ற ப கைல கழக களி தமி இ ைகக (Tamil Chairs) நி வ ப தமி ெமாழி றி த ஆ க நைடெப கி றன. இ த சிற மி தமி ெமாழியி நிைல த த ைமயிைன க பாிமா ற ல உலக
ெகா ெச வத தமி ெசய க பாலமாக அைமகி றன.

ஒ பய ள ெசயைல ெச ய, சி கைல தீ க, திதாக க ெகா ள உ வா க ப ட தா ெம ெபா க வி. இ கணினியி ைகேபசியி
ெசய ப . பய பா அ பைடயி ேநா கினா ஒ ெசய யான , தகவ ெதாட காக ம ம லா ெபா, ேபா கி காக, வ கி பாிவ தைன ெச ய, திைசகைள அறிய, க வியறி ெபற என ப ேவ தள களி
ெசய ப கிற .

” ெசய ைக ணறி மனிதைன மா வத காக அ ல, மனிதைன
ேம ப வத காக உ வா க ப ட ” எ ப . ெசய ைக ணறி (AI)
ெதாழி ப இ உலகளவி ெப மா ற ைத ஏ ப தி வ கிற . றி பாக தமி ெமாழிைய அ பைடயாக ெகா ட ெசய கள , தமி ம களி அ றாட
ேதைவகைள தி ெச வைகயி பல ைமயான அ ச க
த ப ளன. அ த தமி ெசய க ெசய ைக ணறி ைண ட
ெமாழி வள சியி , க வி ைறயி , ப ைற அறி ெப க எ தைகய மா ற கைள ெப ள எ பதைன ேநா காக ெகா இ க ைர அைமகிற .
ெமாழி வள சியி ....

ெமாழி பய பா ைட அதிகாி பதி தமி ெசய களி ப மக
தான . ஊடக களி அ றாட உைரயாட தமி பய பா
ப மட உய காண ப கிற . தமி ெசய க வ வத த
கி ஆக இ த நிைல மாறி
ேநர யாக தமிழி த ட ெச வழ க வ ள .

உலகளாவிய நிைலயி இைணயவழியி க பாிமா ற நிக
தமி ெசய களி ெமாழி வள சி அ ேகா ெசய க ஒ தமி
அகராதி (Tamil Dictionary). இ ெசய மாணவ க திய ெசா கைள
ெதாி ெகா ள ,
ெசா க கான சாியான ெபா ம உ சாி ைப அறிய ைணநி கிற
.

திதா தமி ெமாழி க கவி பிற ெமாழியின விைளயா ைறயி
ெமாழிைய க ெகா Ling / Language Curry எ ெசய .

தமி விைச பலைக, ைகெய, . ர வழி ேதட வ வத Google
Indic Keyboard எ ெசய தமிழி மிக எளிதாக த ட ெச ய அதாவ த கி இ
தமி, மா ற இ த விைச பலைக ெசய உத .
நாவி, வாணி, ெம ெபா ேபா ற ெசய க ெசா பிைழ தி தியாக ,
எ, பிைழ தி தியாக ெசய ப கிறன. ந ன ண ழ ள ல -
ெபா
ேவ பா அறி மய ெகா பிைழகைள தவி கிற . வ ன
மிக ய இட க , மிகா இட க அறி சாிெச கிற .
க ற க பி த ....

தமிழி இல கண , ெச பயில இ கால மாணவ க திணறி வ
ழ அவ கைள விைளயா ேபால AI ல க ெகா ள ஏ வாக
அைமகிற ‘ க க’ ெசய . ப பறியாத கிராம ற மாணவ க வ டார
வழ கி ேபசினா அ ர வழி ளி ேதடலா . Skill India Digital எ
ெசய ம திய அரசா உ வா க ப ட . இ ெதாழி க விைய தமிழி
ெசா த கிற .
ேபா ேத ம ேவைலவா ெப ேநா க தி தமிழி
பயி சிக அளி க ப ெசய களாக நீ க ஐஏஎ ஆகலா , எ பி
எ சி தமி ெசய க உ ளன. இவ தனி சிற ட விள வ
உயி ெம ெசய ஆ . அர ெபா ேத க தயாரா
மாணவ க தமி பாட தி

திறனறிதைல ேம ப வைதேய த ைம ேநா கமாக ெகா
ள ைகேபசி
ெசய உயி ெம . ேத ேநா கிேல க ற உ ளட க
ைத ெகா ள உயி ெம மாணவ க தமி ப
றிய ந ாிதைல வழ கிற .

ேபா ேத க கான ந பி ைகைய வள , தமி ெமாழி திறன ேம ப த உத கிற .
தமி ெமாழிைய சரளமாக வாசி க , எ,த க ெகா ள ப ேவ தமி ப ளிக ம இைணய வழி க வி ைமய க உ ளன. றி பாக, Reading Tamil School ம MNTamilSchool ேபா ற நி வன க 32 மணி ேநர பயி சி, பிர ேயக அ ைடக (32 cards), ம ஆ ரா /iOS ெசய க ல தமி வாசி ைப எளிதா கி றன. 2009 த இய கி வ இ தைகய நி வன க , ந ன க பி த ைறகைள பய ப தி, ழ ைதக கான கைதக த
ெச தி தா க வைர சரளமாக வாசி க பயி சி அளி கி றன.

Arignar - Tamil Learning ெசய , ப ளி ழ ைதக , ப ளி பாட தி ட தி ப (Tamil Nadu School Syllabus) விைளயா க ல எளிதாக தமிைழ எ,த , ப க ம உ சாி க க த ஒ ஊடா (Interactive) ெசய யா . இ ழ ைதகளி க ற திறன ேம ப வ ட , ஆசிாிய களி பணிைய எளிதா க , யமாக தமி க ஆ வ ைத ட வ வைம க ப ள . எ, கைள க பி த , சாியான ெசா , வாசி பயி சிக ேபா ற ஊடா விைளயா க உ ளன. ழ ைதக யமாக தமி க ெகா ள ஊ வி வைகயி வ வைம க ப ள . ஆசிாிய க வ பைறயி பய ப வத , தனி ப ட ைறயி க ெகா பத வசதியாக உ வா க ப ள

க வி ம க ற (EdTech) எ ெசய யான தமி மாணவ க க னமான அறிவிய ம கணித ேகா பா கைள தமிழி விள வத AI வழிகா க (AI Tutors) உ வா க ப ளன. இவ மாணவ களி க ற திற ேக ப பாட கைள மா றி அைம (Adaptive Learning).

கா அகாடமி (Khan Academy - Tamil): கணித , கணினி அறிவிய , இய பிய , ேவதியிய , உயிாியிய ெபா ளிய , ெதாழி ப ம தமி இல கண ேபா ற க னமான பாட கைள மிக எளிய தமிழி ேயா வ வி க ெகா ள இ சிற த தள . இ க ற திறன ேவக ப கிற . ஆாிய க இ ெசய யி ல ஒ ெவா மாணவாி ேதைவைய தி ெச கிறா க . விாிவான காெணாளி விள க க ம பயி சி வினா கைள வழ கிற .
ெபாறியிய , அறிவிய , கைல ம ேமலா ைம ேபா ற ைறகளி உலக தர வா த க விைய இ தியாவி ைல ெக லா ெகா ேச
ேநா க ைத த ைமயாக ெகா ட NPTEL எ க வி ைறயா . இ Swayam எ ெசய யி இய கிற .
NPTEL (National Programme on Technology Enhanced Learning) எ ப இ திய அரசி க வி அைம சக தா (Ministry of Education) ெதாட க ப ட ஒ மிக ெபாிய இய கைல க வி ைற. றி பாக க ாியி பயி மாணவ க ம ம லா க பி த ெதாழி ஆசிாிய க உய தர பாட கைள இ வழ கிற .

இவ றி மா 2400- ேம ப ட பாட க இதி கிைட கி றன.
றி பாக ெதாழி ப (Technical) சா த பாட க இ ேவ இ
தியாவி
த ைமயான தள . இைவ வழ க ய அைன காெணா
பாட கைள எவ இலவசமாக பதிவிற க ெச ப கலா
. சிற த நி ண களி விரி ைரகைள ேநர யாக தமி நா
மாணவ க த க ேத ேக க
.பாட கைள ேக ப இலவச எ றா , அதிகார வ சா றித
ெபற வி ேவா ஒ சிறிய க டண ைத ெச தி இய கைலயி
பதி ெச த பி ன
ேநர யாக ைமய தி ெச ேத எ,த ேவ . இதி வழ க ப
சா றித க ேவைலவா களி ேபா மிக ெபாிய மதி ைப ெப
த கி றன. பல நி வன க NPTEL சா றிதைழ ஒ த த தியாக
க கி றன.
ேநர யாக தமி ெமாழியி அைன பாட க இ ைல எ
றா , பல
கிய பாட க தமி ச ைட (Subtitles) ம பாட றி க
(Transcripts) வழ க ப வ கி றன. க னமான ெதாழி ப க
கைள தா ெமாழியி ப ாி ெகா ள இ ெப உதவியாக இ

க ாியி ப பாட கைள தா த அறிைவ மாணவ க
ெப கி றன . ப ேவைல ேத பவ க த விவர றி கைள
வ ப த உத கிற . ஆசிாிய க ைற சா த ம ைறசாரா க
வியறி
ெப திய ேன ற கைள ெதாி ெகா ள பய ள
வைகயி அைமகிற இ க வி ைற.
மாணவ களி தனி திற ேம பா , க வி அறி , ம ஆ ைம
வள சி உத சில கியமான தமி ெசய க உ ளன. அவ றி , Udemy
உலகளவி பிரபலமான ஆ ைல க ற தள ஆ . த ேபா தமி
ெமாழியி ஏராளமான பயி சிக கிைட கி றன.
இ தனி ப ட ஆசிாிய க த க ெதாி த திற கைள ேயா
பாட களாக பதிேவ வா க . அ வா ஏ ற ப ட ஒ றி பி ட பாட ைத (Course)
ம பண ெகா வா கி, வா நா ,வ எ ேபா
ேவ மானா பா ெகா ளலா . ைகேபசி ெசய ல
பாட கைள பதிவிற க ெச ெகா ளலா . மாணவ க
ஆசிாியைர சா தி காம , த க பி த ேநர தி , மீ
மீ பா யமாக க ெகா ள
.
தகவ ெதாழி ப (Python, Java), ஜி ட மா ெக , ப ச ைத
(Stock Market), ம ய ேன ற சா த பாட க தமிழி அதிக
கிைட கி றன. "ெச ைற தி ட க " (Projects) ல மாணவ க
தா க க றைத ெசய ைறயாக ெச பா க உத கிற . பாட ைத
த ட 'ேகா

தத கான சா றித ' (Certificate of Completion) வழ க ப . மாணவ க க ாியி ப ேபாேத ெம ெபா உ வா க ேபா ற ேவைலவா திற கைள தமிழி க ெகா ெதாழி ப அறிைவ இத க ெபறலா .
க ற ம க பி த (Teaching and Learning) ஆகிய இர உத வைகயி ெதாழி ப த ேபா ெப வள சிைய அைட ள . ஆசிரிய க மாணவ க பாட கைள எளிைமயாக ெகா ெச ல , மாணவ க
யமாக க க உத சில கிய தள க ம ெசய க தமிழி நிர ப கிட கி றன.

ஆசிரிய க கான க பி த உதவி க விகளி ஒ தா Maya AI for Tamil Teaching: தியதா ஒ பாட தி ட கைள (Curriculum) வ வைம க , மாணவ க ேதைவயான வினா -வினா க (Quizzes) ம கைதகைள தமிழி உ வா க இ த ெசய ைக ணறி தள உத கிற .
TNSED Schools: தமிழக ப ளி ஆசிரிய க மாணவ களி வ ைக பதி த , பாட வாாியான க ற திற கைள (Learning Outcomes) ஆவண ப த இ த அர
ெசய ைய பய ப கி றன .
மாணவ க கான விாிவான க ற தள க சில ெசய கைள இ ேக காணலா .
Padasalai.app: இதி Nool (தக கைள வாசி க), Suvadi (றி கைள உ வா க ம பகிர), ம Kalam (ேபா ேத க கான பயி சி) ேபா ற பல பிாி க உ ளன. இ மாணவ களி ஜி ட ைறயி க றைல
ைற ப கிற .
Talkio AI & Talkpal AI: இைவ தமி ேபச பழக வி ல ெபய த தமிழ க ஏ றைவ. ஒ AI ைண ட ேநர யாக உைரயா வத ல உ சாி ம வா கிய அைம கைள ேம ப தி ெகா ளலா .
Language Curry எ ெசய தமி எ, கைள (Scripts) அறி ெகா ள, சாியான இல கண ட க ெகா ள வி மாணவ க மிக பய ள வ வைம ைப ெகா ள .
பைட பா ற .....
திய க கைள, சி தைனகைள, தயாாி கைள ெவளி ெகாண தள பைட பா ற க வி ைற ஆ . இ த க வி ைறைய பிரதிப ெசய களி
கியமான ஒ Skillshare (கி ேஷ) ஆ . இ பைட பா ற மி க திற கைள (Creative Skills) வள பத கான ஒ தள .
ஒ ைற ச தா ெச தினா , அ த தள தி உ ள அைன பாட கைள பா கலா . இதி தமி ெமாழியி ேநர யாக பாட க ைறவாக இ தா , பல கிய பாட க தமி உ ளி ட ெமாழிகளி

ச ைட (Subtitles) வசதிக விாி ப த ப வ கி றன. கிராபி ைச , ைக பட எ த (Photography), அனிேமஷ ம ஓவிய ேபா ற கைலக இ
த ைமயான தள .

பிரதி பி (Pratilipi): இ ெவ கைத ெசா ெசய ம ம ல; மாணவ க த களி வாசி திறைன ேம ப த , இல கிய தகவ கைள
ெதாி ெகா ள , ெசா தமாக சி கைதக எ,தி பழக இ ஒ சிற த தள .
உ ள ட க உ வா க (Content Creation) தயாாி பதி AI யி ப அள பாிய . ச க ஊடக க காக தமிழி கவிைதக , க ைரக அ ல மி ன ச கைள உ வா க ChatGPT ேபா ற க விக இ ேபா மிக சிற த தமிழறிைவ ெப ளன. இைவ ேபா ெஜமினி AI , Meta AI தமிழி ந றாக உைரயாட ய உதவியாள க . இல கண பிைழயி றி தமிழி எ,த இைவ உத கி றன.
ெப லா ஒ ெமாழியி தமி, ெமாழிெபய ேபா வா கிய அைம க ச க னமாக வி தியாசமானதாக இ . ஆனா , த ேபா Neural Machine Translation (NMT) ெதாழி ப ல , மனித க ேப வ ேபா ேற இய பான ெமாழிெபய கைள ரா ேல (Google Translate) ம
ைம ேராசாஃ ெசய க வழ கி றன.
இ வா மன பாட ெச வ ம க ற திற ஆகா . எ ைறயாக இ தா பைட பா ற ட பிர சைனக தீ கா ஆ வ ைத த ன பி ைகைய ெகா ப இ க ற தள . இ திற கைள தவறா வள ெத க உத கிற ேம க ட ெசய க . தகவ ேத த , ெதா த பணியி ...

ஆ பணியி த ப நிைல தகவ ேத த . அதைன ெதாட தகவ கைள ைறயாக ெதா ப அ த நிைலயா . ர வழி ேதட (Voice AI) எ ப ஆ பணியி ேநர ைத மி ச ப கிற . தகவ ேத த அெல சா (Alexa), சிாி (Siri) ேபா ற ெசய களி ப மக தான . இ ேபா தமிைழ ாி
ெகா திற ர ெசய களி ேம ப ள . தக கைள வாசி பத மி த பயனளி ெசய .
□ Speech-to-Text: Google Indic Keyboard எ ெசய நா ேப வைத அ ப ேய தமிழி த ட ெச ெசய .

• Text-to-Speech: திைரயி உ ள தமி உைரய ெப அ ல ஆ ர வாசி வசதி. இ பா ைவ ைறபா உ ளவ க ெபாி உத கிற .
• Hear2Read (தமி ர): தமி ெசா கைள மிக யமாக, எ, பிைழயி றி, தமி நா டவ ேப உ சாி பி ேலேய வாசி .

• ஆ ைலனி தமி தக கைள வா கி ப பவ எனி , பிேள (Google Play Books) இ த ெசய மிக எளிதான . இ ெசய யி ஏேத ஒ தமி தக ைத திற வாசி கலா . ஆனா PDF ஆக இ த ேவ . தகவ ேத த தமி விைச பலைகக த கள ப கிைன அளி கி றன.

ெச ன (Sellinam), விைச (Visai) ேபா ற ெசய க AI-ஐ பய ப தி அ எ ன வா ைத ெசா ல நிைன கிறீ க எ பைத ேய கணி ேதட உத கி றன. ேம எ, பிைழகைள சரிெச கி றன. ” தமி எ, கைள ம ாி ெகா டா எ வள ெபரிய கைள ப விடலா . காரண அதி ள எ த எ, இர மா ப ட ஒ களி ைல. ” எ பா கி.ஆ.ெப.வி வநாத . மா ப ட ஒ க இ லாத ெசா கைள உைடய தமி ெமாழி. ஆதலா , எளிதி கணி ெசா திற ெகா டதாக ெசய க இ கி றன.

வரலா சிற கைள, ஜி ட அனிேமஷ ம ம மீ யா ல எதி கால தைல ைற ெகா ெச வத கான ைறேய ஜி ட ஆவண ப த (Digital Archiving). பழைமயான தமி இல கிய க , ைலவ வ க ம அரிய க ஜி ட மயமா க ப வதா , அைவ எதி கால ச ததியின அழியாம கிைட . இ சீரிய பணிைய, தமி ைணய க வி கழக ெச வ கிற . தமி ைணய க வி கழக (Tamil Virtual Academy) ஆயிர கண கான அரிய தமி க , அகராதிக , ைலவ வ க ம வரலா ஆவண கைள ஜி ட வ வி இலவசமாக வழ கிற .

எதி ெகா சவா க

ெசய ைக ணறி எ ப ஒ ைமயான வா ேபா ற . அைத சரியான ைறயி பய ப தினா க வி, ம வ ம அறிவிய மிக ெபரிய ர சிைய ஏ ப தலா ; மாறாக கவன ைறவாக ைகயா டா

அ சவா கைள உ வா . மாணவ க ம ெதாழி ப ஆ வல க இ த

ெதாழி ப ைத ஒ ' ைண க வியாக' ம ேம ைகயா த க அறிைவ வள ெகா வேத சிற த . இைத தா , ச யா நாெத லா (Satya Nadella) எ ற வ ந , "ெதாழி ப எ ப மனித க அதிகார அளி பதாக இ க

ேவ . AI-ைய நா உ வா ேபா , அ மனித களி ேவைலகைள திற கைள ேம ப வைகயி இ க ேவ ேம தவிர, மனித கைள நீ வதாக இ க டா ." எ கிறா .

AI ெதாழி ப தமிழி ,ைமெபற இ சில தர சி க க உ ளன. ஆ கில ைத ஒ பி ேபா இைணய தி தமி தர க மிக ைற எ பதா , யமான கைள ெபற ஆ க ெதாட நைடெப வ கி றன. ஒ ேம ப ட பழைமயான பதி க இ பதா , ல பாட

ேவ பா ஏ ப கிற . இ ஆ ேதட பணியி ெதா வி ைன ஏ ப கிற .

க

தமி ெமாழி ைய ந ன கால தி ஏ ப வள ெத களமாக AI

ெதாழி ப வள வ கிற . தமி ைழ ெவ ஏ ேடா ைவ தி காம , ந ன கால தி ஏ ப கணினியி அ ேலபசியி உயி ட ைவ தி க உத கிற AI . எ ெபா, ேவ மானா , எ ேவ மானா , எ கி ெகா ப கலா , மாதிரி ேத க எ,தலா . இதனா ேநர ேத கைள எளிதி எதி ெகா ள ஏ வாகிற . அேத ேநர தி ேநர , ெசல இர ேம ைற .

ச ட , ம வ , அறிவிய ேபா ற உய க வி ைறகளி ெதாழி ப உதவி ட தமிழி உ ள ட க கைள (Content Creation) உ வா த . தமி ெசய க ெவ ெம ெபா க ம ம ல; அ வ தமி ெமாழியி உயி ைப த கைவ ஜி ட க வி க . ெமாழி ைய அழியாம பா கா பதி , உலகளாவிய அர கி தமி ைழ ஒ ந ன ெமாழியாக கா சி ப வதி ெசய களி ப அள பரிய .

தமி ெசய க உலகளாவிய க வியி ெதாழி ப ாீதியாக ெமாழி

ாீதியாக ெப ப கா றினா , லபாட ேவ பா க , எ, தமி - ேப தமி ேவ பா க , இல கண பி ைழ க என சில ைன ட கைள ச தி க ேநாி கிற . ஆனா , கிராம ற ம வ ைம ற மாணவ களி ப ைற அறி ெப க, அ ைன ைற வ ந களாக வல வர வழிவ கிற இ தமி ெசய க ..

ைண ப ய

கி.ஆ.ெப.வி வநாத , தமிழி சிற , எ டா பதி :2003, பாரிநி ைலய , ெச ைன – 1, ப . 50.

ணயதள : https://apps.apple.com/in/app/arignar-tamil- learning/id6468196434?l=ta

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A Study on Socio-economic Condition of Women Rubber Plantation Labourers in Kanyakumari District with Special Reference to Vilavancode

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Abstract

The aim of this paper is to find economic and social position among women workers in rubber plantation. Socio-economic conditions vastly differ across the world. Globalization has become the buzzword on the lips of businessmen, politicians, religious leaders, educators, students, the rich and the poor. It involves every aspect of life-economic, political, social and cultural and religion. The rubber plantation workers in Kanyakumari district are by and large affected by the problems of ignorance and poverty. It is a pity that they are unable to extricate themselves from the cruel clutches of poverty despite their migratory character assiduity and the massive support given by the trade unions and also a fairly high salary or wage rate. The study is to find the socio-economic status of women employees in rubber plantation. The study focuses on the age, experience and socio security level of women employees. Convenient sampling techniques is involved. Percentage analysis is used for analysis and interpretation.

Keywords: Climate Change and Support Price, Price Fluctuation, Socio Economic

Introduction

Rubber has played a vital role in the plantation crops of India. Rubber is an elastic substance made from sticky; milky white liquid called latex extracted from the bark of the rubber tree (Hevea Brasiliensis) through a process called tapping. Rubber is a Brazil native crop introduced in India by the British; however, cultivation in commercial scale were initiated as early as 1873. It plays a vital role in the National Economy. In the early years rubber was grown only in Kerala and Kanyakumari District in Tamil Nadu, which are the traditional rubber growing areas of the country. But currently, Rubber is also grown in Tripura, Assam, Meghalaya, Mizoram, Manipur, Goa, Coastal Karnataka, Orissa, Andhra Pradesh, Madhya Pradesh and West Bengal. India is the sixth largest producer and consumer of natural rubber (Binitha, 2018). This paper seeks to examine. the living and working condition of the rubber plantation and to analyze their level of income and expenditure Kanniyakumari district. This district accounts for 98 percentage of rubber production. It has suitable soil and climate for the cultivation of rubber trees. Out of 91807 hectares of total crop area, rubber is cultivated in 19500 hectares. There are 126 small scale rubber-based industries registered under the (Selvia, 2012) District Industries Centre (DIC). They provide employment to 1874 people. Rubber is being cultivated in three taluks of the district: Kalkulam Taluk - 180 rubber estates, Thovalai Taluk - 13 rubber estates, Vilavancode Taluk - 230 rubber estates according to Rubber Board, Marthandam. (Binitha, 2018) According to department of Economics and Statistics of Kanyakumari District there are 41 registered rubber estates with 7373.126

hectares of land in which there are 1998 male labourers and 988 female labourers. Land coverage under rubber plantation in Kanyakumari District is 27407 hectares. (District Statistical Handbook, 2015). This paper seeks to study the living and working condition of the rubber plantation and to analyze their level of income and expenditure in Kanyakumari district.

One of the prominent plantation crops of our country is rubber and has considerable significance to the Indian economy. Rubber is an elastic substance made from sticky, milky white liquid called latex extracted from the bark of the rubber tree (Hevea Brasiliensis) through a process called tapping. Rubber is a brazil native crop introduced in india by the british; however cultivation in commercial scale were initiated as early as 1873. In 1895 the first rubber plantations were set up on the hill slopes of Kerala. In 1902 the first commercial Hevea plantations were established at Thattekadu, Ernakulum District, Kerala. In India rubber plantations are spread over 5.97 lakh hectares cultivated in 16 states. It has been traditionally confined to Kerala and Kanyakumari District of Tamilnadu of which 90% of the total output is from Kerala, next comes Kanyakumari District, followed by Tirpura with 4%. In Tamil Nadu, Nilgiri, Madurai, Kanyakumari, Coimbatore and Salem are the chief rubber producing districts of Tamil Nadu.

Review of Related Literature

In any research project it is essential to understand what has already been done in the specific topic that the researcher chooses and what has been done in the wider subject area of that topic. A Literature review is a text written by someone to consider the critical point of current knowledge including substantive finding as well as theoretical and methodological contributions to a particular topic. Literature reviews are secondary sources, and as such, do not report any new or original experimental work. Also, a review of literature can be interpreted as a review of an abstract accomplishment.

Mahalakhsmi, Assistant professor, Bharthiar University Art and Science College, Dec 2012 (IJSETR) volume 1, in her study on the Socio-economic status of women employees in tea plantation industries found out that no. of women workers are facing many problem in the tea plantation. Since women workers are engaged more than the male workers. The study is basically focus on their living condition, wages earning and socio-security benefit. The important factor for their development and the problem faced by the employees are also identified.

V Ushadevi And V.N Jayachandran (2001) A Project of Kerela Research Programme on Local Level Development (krill) centre for research studies thiruvanthapuram. Socio-economic profile of rubber tappers in the small holding sector. The study basically focused on the tapper's workers. The study found that tapper work is not an easy work as it requires skill and is labour intensive for the good health of the rubber tree and maintaining the longetivity of its production period.

A comparative study of the informal conditions of the plantation labourers of india labourer of India and Sri Lanka. By Neelam Choudhary and Deeksha Tayal. The study focuses on the section of plantation labourers, who are directly employed by the employer are and contract workers. The study also suggests the effectiveness of any formalization strategy would require collective involvement and social dialogue among all the key players in the plantation sector.

Government of India (1980) Labour Bureau Ministry of Labour Socio-economic condition of women workers in plantation action. In this study the Government of India focused on the plantation sectors of the labour economical life.

Sanyal Joyjit, Dr. Sikidar Sujit, Timung Ajit, (2015) , in their paper "Socio-Economic Condition of Rubber Plantation Workers- A Synoptic Study", has presented that the nature of work is very hard. They are engaged in 8-10 hours of work. Most of the employees have no other tasks leaving apart the plantation work. The region surrounding still remains underdeveloped so the employees have no other sources of employment to improve their lifestyle. The present wage structure is not adequate to run their family. They are leading life in poor condition and also not able to provide proper education facilities to their children.

Government of India Ministry of Labour & Employment Labour Bureau, (2008- 09) conducted a survey and found out that economic condition of the Workers, particularly women workers, in rubber plantations of Tripura is poor. About 50 per cent sampled women workers in the plantations in the state are employed either on temporary or on casual basis. At all-India level only 7 per cent women workers are temporary or casual. Housing facility is available to only 15 per cent workers in rubber plantations of Tripura whereas at all-India level this figure is more than 75 per cent. The average daily earnings of workers are also lowest in the state"s plantations of rubber when compared with these plantations of other states covered during the survey. Various other benefits provided to the workers are also minimal in the state vis-à-vis other states.

Bent Hansen, Bhalla, Errikson, Roberts and Pranab Bardhan have studied the features of 'attached labour' in agricultural sector. Attached labourers are defined as those who are more or less in continuous employment. Their findings show that tighter labour markets lead to more tied labour contracts. In slack labour markets with high un employment , the employer often does not bother to have long term contracts with labour since he is surer of the labour supply.

Thomas C.A (2004) conducted a study focus on the rubber growers of Kerala. The study states that the small rubber growers face a number of problems from the planting stage to the marketing of the product.

Balz Strasser (2009) explained that the poorest and most marginal holdings derive only a small percentage of their income from their own rubber trees. However, they earn important income from their work as tappers and labourer on neighbouring plantations and are thus altogether very dependent on income from the natural rubber sector.

Karunakaran (2017) The study revealed that prices were so low so that the rubber cultivators cannot even pay workers wages and the recent unprecedented volatility in prices declined rubber production leads to the falling standard of living of the rubber farmers in Kerala. Rubber cultivators in Kerala are mainly small growers and any financial constraints, fluctuations in price or backwardness in technology will affect the growers considerably.

Statement of the Problem

Rubber is one of the important horticultural crops in India. It has a commercial value and it assumes impotent from the point of view in employers working condition. The percent

work “Workers work contribution in rubber plantation” is an attempt to study the living and working condition of the rubber plantation, analyze their level of income and expenditure and give suggestion for improving the status and working condition of rubber plantation in Kanniyakumari district.

Objectives

The specific objectives of the study areas follow

1.To study the living and working condition of the rubber plantation in Kanniyakumari district.

2.To analyze their level of income and expenditure.

3.To give suggestion for improving the status and working condition of rubber plantation.

Methodology

The required information for the present study has been collected both from Primary and Secondary data. The information has been collected from the respondents through the separate interview schedule for the rubber plantation labour. The Secondary data required for the study were collected from the various books, Rubber the various articles published in Newspapers, and Magazine.

Sample Design

The Samples were selected by Convenience Sampling Technique. The Total number were samples were collected 25 Respondents. The study was conducted among the select rubber plantation labours in Kanniyakumari district.

Collection of Data

The interview schedule has been used for collection of primary data from the rubber plantation labours employed in the factory.

Statistical Tools of Analysis

The analysis was done by the use of Excel and SPSS. The various statistically tools applied to analysis the primary data were presented percentage analysis to arrive at required from the study. For effective analysis and easy understanding, the data were tabulated.

Rubber Plantation Labour in Kanyakumari District

The data analysis required for the study was collected from the primary data. Primary data were collected directly with the help of interview schedule from the rubber plantation labours in Kanniyakumari district. The sample was selected by administering convenience sampling technique. The total number of samples was 25 and was selected among the rubber industry in rural area. The present study socio-economic conditions of sample rubber workers like, age, educational status, marital status, sources of income size of family accommodation monthly income number of days employed per year type of saving nature of work are analysed. The various statistically tools applied to analysis the primary data were presented analysis to arrive at required from the study. For effective analysis and easy understanding.

Table 1.1 Age Wise Classification.

S: No	Particulars	Rubber Workers	Percent
1	Up to 20 year	7	28
2	21 year to 40 year	4	16
3	41 year to 60 year	11	44
	Above 61 year	3	12
Total		**25**	**100.0**

Source: Primary data

Table.1.1 gives details about the age-wise classifications of rubber workers. Working in rubber plantation labours work out of 25respondents studied only 7(28per cent) of them belongs to the age between Up to 20 year in rubber plantation labours, than 4(16per cent) respondents belong to the age group among 21 year to 40 year in rubber plantation labours, and 11(44per cent) respondents belong to the age group between 41 year to 60 year and additional, the period of old people above Above 61 year age are only12 percent of rubber plantation labours.

Table 1.2: Educational Status of the Rubber Workers

S. No	Particulars	Rubber Workers	Percent
1	illiterate	4	16
2	Primary	10	40
3	Higher/Secondary	6	24
4	Degree/ Technical	5	20
5	Post Graduate	0	0
Total		**25**	**100.0**

Source: Primary data

Table:1.2 shows that the educational status of the sample rubber workers in the study area. The rubber plantation labours 40per cent of primary level education, 24per cent of the rubber workers are Higher/Secondary level 20per cent of the rubber workers are Degree/ Technical and among the total sample in rubber workers.

Table 1.3: Marital Status Wise of the Rubber Workers

S. No	Particulars	Rubber Workers	Percent
1	Married	21	84
2	Un married	2	4
3	Divorce	0	0.0
4	Widow	3	12
Total		**25**	**100**

Source: Primary data

Table: 1.3 shows that the gender married rubber workers are 84per cent of the rubber plantation labour and4per cent of the labours are un-married in rubber plantation labours, 3per cent labour are widow worker in rubber plantation.

Table 1.4: Sources of Income of the Rubber Workers

S. No	Particulars	Rubber Workers	Percent
1	Rubber	15	60
2	Other Agri crops	6	24
3	Employment	4	16
Total		**25**	**100.0**

Source: Primary data

Table 1.4 states that the various steps of income distribution of the sample respondents in the study area. The rubber plantation labours are 60 per cent of the workers earn income in rubber, but.24per cent of the labour earns income in Other Agri crops and other than 16 per cent labours are earn income in employment.

Table 1. 5: Size of Family Classification of the Rubber Workers

S. No	Particulars	Rubber Workers	Percent
1	1 member to 3 members	4	16
2	4 members to 6 members	15	60
3	Above 6 members	6	24
Total		**25**	**100.0**

Source: Primary data

Table 1.5 reveals that the 16 percent of labour size of family 1 member to 3 members and 60percent of the plantation labour family size 4 members to 6 members and 24percent of labour size of family Above 6 members.

Table 1.6: Accommodation Classification of the Rubber Workers

S. No	Particulars	Rubber Workers	Percent
1	Owned House	16	64
2	Rented House	9	36
Total		**25**	**100**

Source: Primary Data

Table :1.6 shows that almost 64 percent of the labours in the plantations live in their Owned House. Whereas the36percent of labours stay in Rented House.

Table 1.7: Monthly Income of the Rubber Workers

S. No	Particulars	No. of Respondents	Percentage
1	Less than 7000	1	4
2	7000 - 10000	2	8
3	10000 - 13000	14	56

4	13000 - 15000	5	20
5	Above 15000	3	12
Total		**25**	**100**

Source: Primary Data

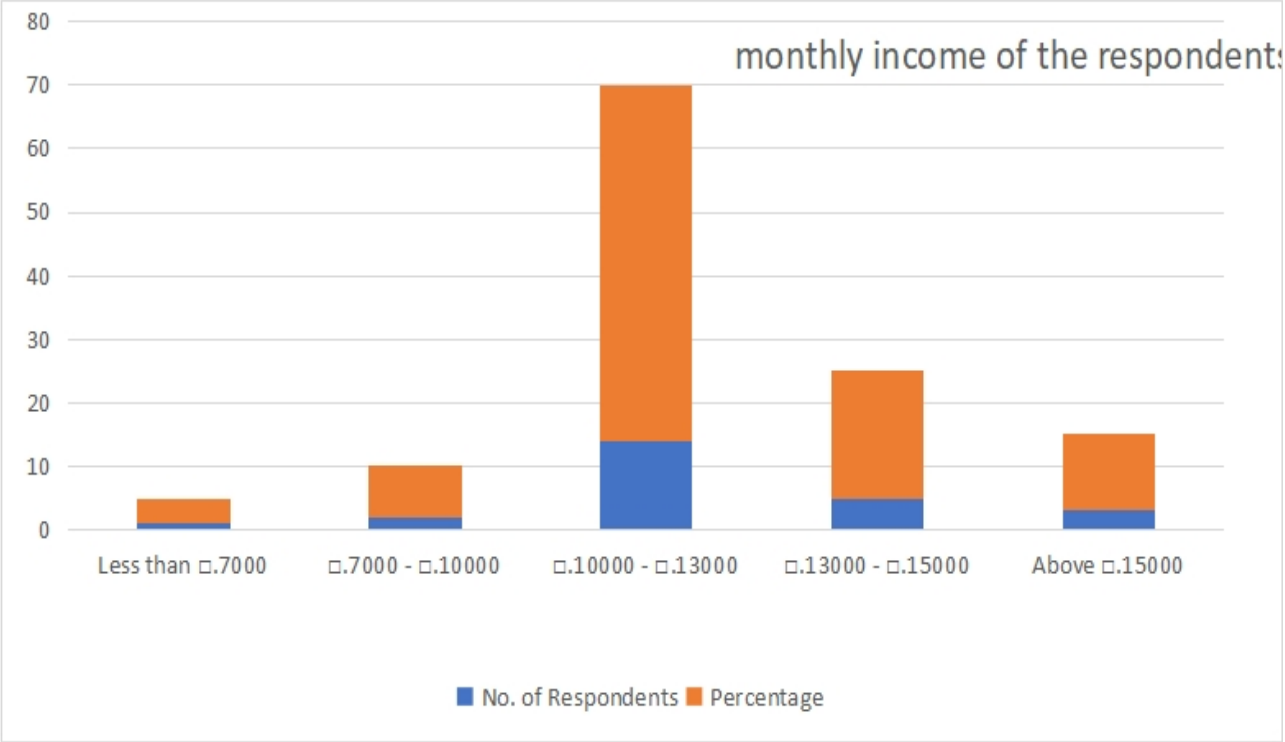

Chart 1.1. Monthly Income of the Respondent

Table 1.7 Implies that the various steps of income groups, 4per cent of rubber plantation labours earn less than 7000. It is significant to note that 8 per cent of rubber plantations labours earn between 7000 - 10000, 56 per cent of labours earn an income in the range of 10000 - 13000,20 per cent are in 13000 – 15000and 12percent are having Above 15000

Table 1.8: Monthly Family Expenditure of the Rubber Workers

S. No	Particulars	Rubber Workers	Percent
1	Below 5000	6	24
2	5000 -10000	10	40
3	10000-15000	7	28
4	Above 15000	2	8
Total		**25**	**100**

Source: Primary Data

Table 1.8 shows that it is understood from Table 1.6 that the rubber workers who spend a monthly expenditure of 5000 -10000, Below 5000, 10000-15000 and above 15000constitute the highest, average and the lowest 24, 40, 28and 8 respectively. Hence, 10rubber workers (40per cent) spend a monthly family expenditure of 5000 -10000 which is the maximum.

Chart 1.2 Monthly Family Expenditure of the Respondent

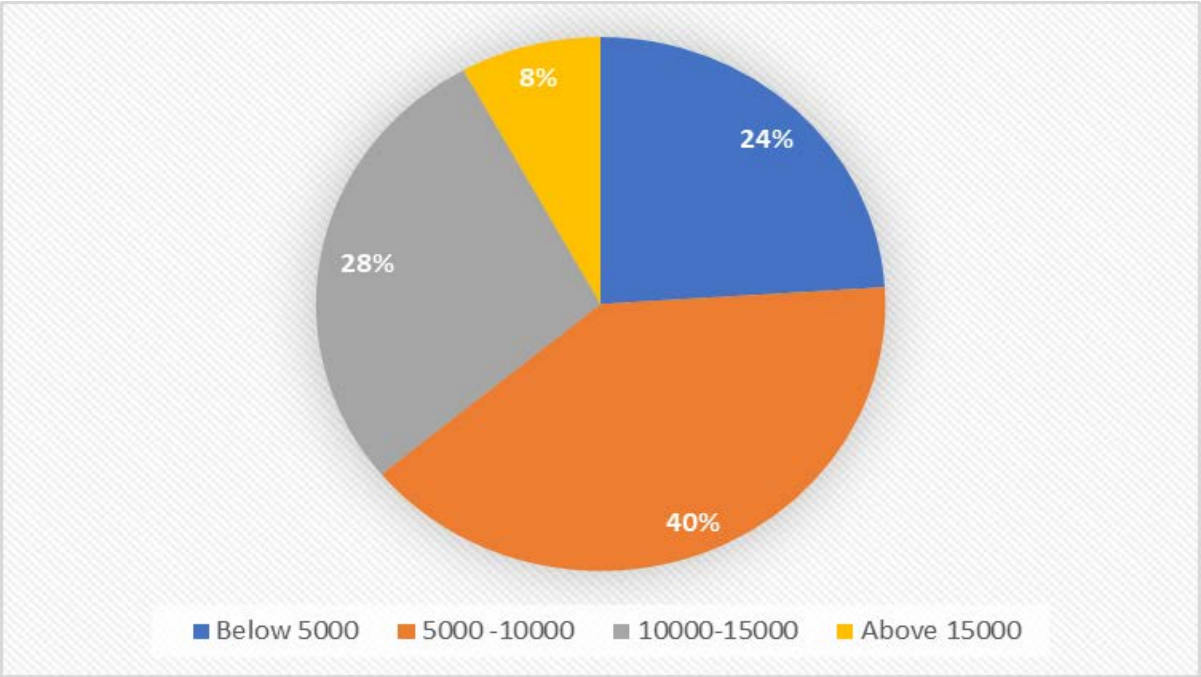

Table 1.9: Number of Days Employed Per Year of the Rubber Workers

S. No	Particulars	Rubber Workers	Percent
1	Up to 100 days	2	8
2	100 to 200 days	5	20
3	200 to 300 days	18	72
Total		**25**	**100**

Source: Primary Data

Table 1.9 It is found that the number of days employed per year classification of the rubber workers in 8per cent of units of rubber plantation labours working in Up to 100 days per year, whereas in 20 per cent units of the labours working in 100 to 200 days per year. Around 72 per cent of unit's labours working in 200 to 300 days per year.

Table 1.10: Type of Saving of the Rubber Workers

S. No	Particulars	Rubber Workers	Percent
1	Chit Fund	9	36
2	Post Office/Bank Deposit	4	16
3	Insurance	2	8
4	Gold Investments	4	16
5	No Savings	6	24
Total		**25**	**100**

Source: Primary Data

Table 1.10 shows that the 16percent of the labours save their Chit Fund36 percent of the labour save their salary in Post Office/Bank Deposit, 8percent of the labour save their salary in Insurance, 16per cent of the labour save their Gold Investments, 24per cent of labour save they are in No Savings.

Table 1.11: Nature of Work of the Rubber Workers

S. No	Particulars	Rubber Workers	Percent
1	Tapping	9	36
2	Field work	16	64
Total		**25**	**100**

Source: Primary Data

Table 1.11 shows that 68.9 percent of the labour's nature of work at Tapping, and 31.1 percent of the labour's nature of work at Field work.

- •44 percent. Of the employees are in the age group between 41 to 60 years
- •84per cent of rubber plantation labours are Married.
- •60percent of the rubber plantation labours family size. Belongs to4 to 6 members
- •64 per cent of the rubber plantation labours live in their Owned House.
- •56 cent of rubber plantation labours earn an income in the range of 10000 - 13000.
- •40 per cent of rubber plantation labours spend a monthly family expenditure of 5000 - 10000.
- •72 cent of unit's labours working in 200 to 300 days per year.
- •36per cent of the rubber plantation labours save their salary in chit funds.
- •64 per cent of the rubber plantation labours nature of work at fields.

Findings and Discussion

The study analyses the socio-economic condition of 25 women rubber plantation labourers in Kanyakumari District, with special reference to Vilavancode. The results show that most respondents belong to the middle-age group, as 44 percent are between 41 and 60 years. Educational attainment is low, with 40 percent having only primary education and 16 percent being illiterate. This limits their access to better employment opportunities.

Most of the respondents are married, forming 84 percent of the sample, which indicates their important role in supporting family income. Rubber plantation work is the main source of income for 60 percent of the respondents. The majority, 56 percent, earn between ₹10,000 and ₹13,000 per month, while 40 percent spend ₹5,000 to ₹10,000 on monthly family expenses. This shows that their savings capacity is limited.

The study also reveals that 72 percent of the respondents are employed for 200 to 300 days per year, suggesting relatively regular employment. However, 24 percent have no savings, and most workers depend on informal savings such as chit funds. Overall, the findings indicate that women rubber plantation labourers have moderate but insecure socio-economic conditions. Better wages, welfare schemes, health support, financial literacy, and alternative employment opportunities are needed to improve their living standards.

Conclusion

The present study brings to the social conditions such as the Age, Educational Status, Marital Status, Sources of Income, Size of Family, Accommodation, Monthly Income, Monthly Family Expenditure, Number of Days Employed Per Year, Type of Saving and Nature of Work. Most of the employees have no other tasks leaving apart the plantation work. The region surrounding still remains underdeveloped so the employees have no other sources of employment to

improve their lifestyle. The present wage structure is not adequate to run their family. They are leading life in poor condition and also not able to provide proper education facilities to their children. Only things they appreciate is that they have free water facilities, accidental benefit, maternity benefit, rest shelter facilities, education facilities with which overall they are moderately satisfied as a whole. The government and Rubber Board take care and make more steps to boost and protect rubber producers by considering their contributions to the country and society.

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Regulatory Adaptation and Cultural Training as Drivers of Project Success: The Mediating Role of Communication Efficiency—Evidence from Yunnan Construction and Investment Holding Group

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Abstract

Purpose: Cross-border infrastructure projects encounter combined pressures from host-country regulation and culturally diverse project. Drawing on institutional theory and communication theories, this study tests whether regulatory adaptation (RA) and cultural training (CT) drive project success (PS) and whether communication efficiency (CE) mediates these relationships in the context of Yunnan Construction and Investment Holding Group (YCIH) overseas delivery. **Method:** A mixed-method design was adopted. Quantitatively, a structured questionnaire (23 measurement items) was used with project personnel connected to YCIH overseas projects (N=412). A SEM/PLS-SEM style approach with bootstrapping tested the measurement model, direct effects, and mediation. Qualitatively, 18 semi-structured interviews were used to triangulate interpretation of coordination frictions and improvement levers. **Findings:** RA and CT positively affect CE (β=0.347 and β=0.359, $p<0.001$). CE positively affects PS (β=0.406, $p<0.001$). RA and CT also show positive direct effects on PS (β=0.245 and β=0.160, $p<0.001$). CE partially mediates the relationships of RA→PS and CT→PS via significant indirect effects (β=0.141 and β=0.146, $p<0.001$). The model explains 33.9% of variance in CE and 43.6% of variance in PS. **Originality/Implications:** The study integrates regulatory capability-building and cultural capability-building into a communication-based mechanism for international project success, providing actionable guidance for contractors operating across institutional and cultural boundaries. Implications emphasise the co-design of compliance routines, cultural training, and communication infrastructure to accelerate decision cycles and reduce rework.

Keywords: Communication Efficiency, Cultural Training, International Construction, Mediation, Project Success, Regulatory Adaptation, Southeast Asia, YCIH

Introduction

International construction is increasingly delivered through cross-border networks in which contractors must comply with host-country regulatory systems while coordinating culturally diverse teams and supply chains. These environments are characterised by institutional distance (laws, permits, enforcement styles, contract governance) and cultural distance (language, work norms, power distance, and risk attitudes), both of which can impair schedule, cost, and quality outcomes (Lin et al., 2021; Lovrenčić Butković, 2021). Contemporary project standards therefore define project success as

multi-dimensional, including scope, time, cost, quality, safety, and stakeholder outcomes.

Review of Related Literature

Yunnan Construction and Investment Holding Group (YCIH) is a major Chinese construction and investment group with extensive domestic delivery and growing overseas presence. In neighbouring Southeast Asia, YCIH-type delivery operates in contexts where host-country approvals, land and environmental requirements, and multi-party coordination are especially salient (L. Li et al., 2022; Liu et al., 2016; Meng et al., 2025). The Vientiane–Vang Vieng expressway in Laos, which required coordination across local governance and project partners, illustrates the typical regulatory and communication intensity of cross-border transport delivery.

The project management literature recognises that regulatory complexity and cultural diversity influence performance (Abdalla et al., 2024; Borges et al., 2024). Compliance risk reviews identify regulatory non-conformance as a frequent root cause of disputes, delays, and rework. Meanwhile, cross-cultural research indicates that multicultural teams can either amplify performance through diverse knowledge or undermine performance through misunderstanding and conflict.

However, less is known about the organisational mechanisms translating these pressures into project success (Banihashemi et al., 2017; Viswanathan et al., 2020; Ye et al., 2022). This study proposes that communication efficiency (CE)—the speed, clarity, completeness, and closure of information exchange—mediates the effects of regulatory adaptation (RA) and cultural training (CT) on project success (PS). Communication is repeatedly linked to construction outcomes through reduced conflict, clearer accountability, and faster decision-making (Al Nahyan et al., 2019).

Accordingly, the study asks: To what extent do regulatory adaptation and cultural training drive project success in YCIH overseas delivery contexts, and does communication efficiency mediate these relationships? The manuscript contributes by operationalising RA and CT as measurable capabilities, testing mediation using SEM-style analysis, and providing a context-sensitive discussion for Chinese contractors operating in Southeast Asia.

Regulatory Adaptation and Institutional Theory

Regulatory adaptation (RA) denotes an organisation's capability to interpret, internalise, and operationalise host-country requirements across permits, environmental and safety rules, labour regulations, tax and customs processes, technical standards, and contractual governance (Iqbal et al., 2021; Liu et al., 2024; Viswanathan & Jha, 2020). In international construction, regulatory complexity increases because standards and enforcement can differ by jurisdiction and shift during the project life cycle.

Institutional theory suggests that legitimacy and performance improve when organisations align with formal rules and informal expectations of the host environment (Feng et al., 2024; Lin et al., 2021). For international contractors, alignment reduces regulatory friction, shortens approval cycles, and improves access to resources and stakeholder support.

Construction compliance research further shows that non-compliance can cascade into stop-work orders, redesign, insurance issues, penalties, and claims. Systematic reviews and empirical studies highlight compliance risk as a critical threat to delivery reliability and trust (Meng et al., 2025; Wang et al., 2024; Weng et al., 2021). In this manuscript, RA is treated as a project capability that includes regulatory scanning, early authority engagement, localisation of documentation workflows, and internal compliance training.

Cultural Training, Cultural Intelligence, and Learning Theory

Cultural training (CT) refers to structured interventions that develop the knowledge, skills, and attitudes required for effective cross-cultural collaboration. In international construction, CT may include language support, negotiation protocols, safety norms, leadership expectations, and community engagement scripts (Cui et al., 2019).

Cultural intelligence theory frames cross-cultural effectiveness as a learnable competency that improves adjustment, trust building, and interaction quality (Eyiah et al., 2025; Ye et al., 2022). Empirical research shows that training supports performance by reducing uncertainty and improving perceived self-efficacy in culturally unfamiliar settings.

From a learning theory perspective, CT builds shared mental models and behavioural routines in multicultural teams (Abdalla et al., 2024; Borges et al., 2024; Konanahalli & Oyedele, 2016). These routines support consistent communication norms and reduce conflict in interdependent work, improving the team's ability to integrate technical and contextual knowledge across boundaries.

Communication Efficiency and Communication Theories

Communication efficiency (CE) reflects the extent to which project information flows quickly, clearly, and with traceable closure. It includes speed of issue escalation, clarity of technical instructions, accessibility of documents, meeting effectiveness, and feedback loops across organisational levels and geographic distance (Liu et al., 2016; Liu et al., 2020).

Media richness perspectives suggest that complex, ambiguous tasks require richer communication channels and interactive feedback. In distributed project teams, hybrid communication—combining formal platforms with informal exchanges—is critical to maintaining coordination quality (Ding et al., 2024).

In cross-border construction, CE is inseparable from regulatory and cultural work because compliance interpretation and cultural meaning-making happen through communication. Efficient communication reduces misinterpretation of requirements, accelerates design approvals, and prevents claims by creating shared situational awareness and clear decision records (Feng et al., 2024; Lin et al., 2021; Malik et al., 2021).

Objectives

The shifting of project success research

Project success research has shifted from the 'iron triangle' toward multi-dimensional evaluations that include safety, stakeholder outcomes, and learning. Contemporary

standards emphasise outcomes and value creation alongside delivery constraints (Wang et al., 2024; Weng et al., 2021).

Regulatory adaptation should therefore matter because it reduces compliance risk and transaction costs while improving legitimacy and collaboration with authorities. Empirical work on institutional distance indicates that better institutional fit supports performance through fewer disruptions and improved resource access.

In construction, compliance failures frequently trigger stop-work events, redesign, and claims (L. Li et al., 2022; Lovrenčić Butković, 2021; Ye et al., 2022). Reviews and sector studies emphasise the need for proactive compliance routines to protect schedule and quality performance.

- Hypothesis 1 (H1): Regulatory adaptation positively influences project success.

Cultural training

Cultural training is discussed in both expatriate and project-team literatures as a means of improving adjustment, cooperation, and knowledge sharing (Abdalla et al., 2024; Lei et al., 2017). Studies link CT to performance through stronger cultural intelligence, reduced stress, and better interaction quality (Eyiah et al., 2025).

International construction projects are sensitive to cultural frictions because tasks are interdependent and safety-critical; misunderstandings can quickly become quality defects or safety incidents. Diversity can be beneficial when supported by trust-building and communication routines, which CT is designed to develop (Eyiah et al., 2025; Suleiman, 2022; Yap et al., 2018).

Therefore, CT is expected to improve PS by enabling smoother coordination, reducing avoidable conflict, and improving stakeholder interactions, especially where contractor personnel must collaborate with host-country counterparts.

- Hypothesis 2 (H2): Cultural training positively influences project success.

The influence of regulatory adaptation

Regulatory adaptation is likely to improve communication efficiency because compliance work requires translation of rules into operational messages, documentation, and decision trails (Lin et al., 2021; Malik et al., 2021; Viswanathan & Jha, 2020). Strong RA clarifies what must be communicated, to whom, and on what schedule.

Moreover, compliance systems institutionalise communication routines such as checklists, inspection records, document control, approval workflows, and escalation paths. Such routines reduce ambiguity and shorten feedback loops, thereby improving CE and reducing rework (Gamil & Abd Rahman, 2023).

- Hypothesis 3 (H3): Regulatory adaptation positively influences communication efficiency (Gamil & Abd Rahman, 2023; Liu et al., 2024).

Cultural training in communication efficiency

Cultural training should improve communication efficiency by reducing semantic misalignment and standardising communication norms. Training can increase awareness of different feedback styles, meeting etiquette, decision norms, and conflict approaches,

supporting a shared mental model across cultures (Al Nahyan et al., 2019; Borges et al., 2024; Cui et al., 2019).

In hybrid and remote collaboration contexts, communication friction increases due to fewer informal cues and reduced opportunities for spontaneous clarification. Studies in virtual exchange and teleworking emphasise the value of structured routines and culturally sensitive practices to sustain coordination effectiveness.

- Hypothesis 4 (H4): Cultural training positively influences communication efficiency (Suleiman, 2022).

Communication efficiency as a mediator

Mediation logic suggests that RA and CT may drive PS partly because they improve CE, which then enhances coordination quality, reduces conflict, and accelerates decision-making (Liu et al., 2016; Weng et al., 2021). Communication is widely associated with construction outcomes and often functions as the pathway by which organisational capabilities translate into performance.

Efficient communication supports faster compliance responses and reduces approval cycle times; it also increases mutual understanding and willingness to share knowledge across cultural boundaries. Therefore, CE is expected to mediate the effects of both RA and CT on PS (L. Li et al., 2022; Liu et al., 2020; Lovrenčić Butković, 2021).

- Hypothesis 5 (H5): Communication efficiency mediates the relationships between (a) regulatory adaptation and project success and (b) cultural training and project success.

Research Gap

First, many studies treat regulation and culture as background conditions rather than as measurable, buildable capabilities. This limits the actionable guidance available to firms aiming to institutionalise overseas delivery practices (Lei et al., 2017; Viswanathan & Jha, 2020).

Second, while communication is frequently identified as critical, fewer studies formally test communication efficiency as a mediator linking capability-building activities (compliance routines, training investments) to multi-dimensional project success in international construction (Banihashemi et al., 2017).

Third, empirical evidence from Chinese state-owned contractors operating in nearby Southeast Asian markets is still limited in peer-reviewed work, despite extensive activity. This study addresses these gaps by testing a mediation model in the YCIH context (Lei et al., 2017; Lovrenčić Butković, 2021; Viswanathan & Jha, 2020).

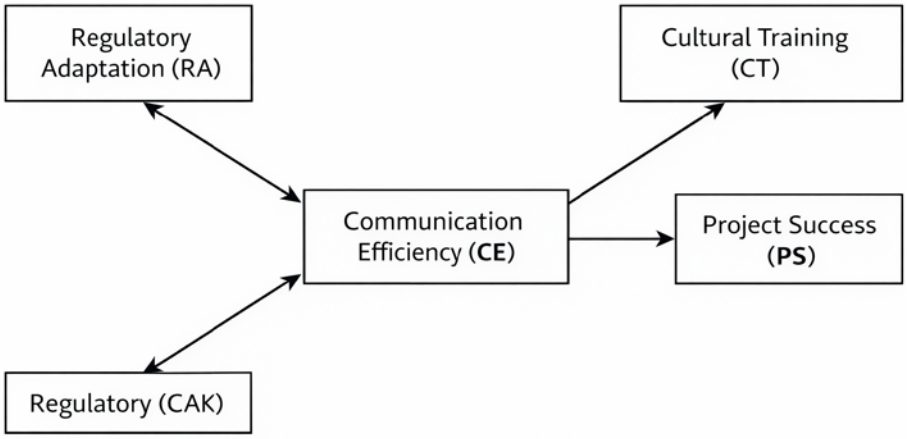

Figure 1: Theoretical Model

The model specifies direct paths from Regulatory Adaptation (RA) and Cultural Training (CT) to Project Success (PS), direct paths from RA and CT to Communication Efficiency (CE), and a mediating path from CE to PS.

Methodology

A mixed-method design was adopted. The quantitative component is a cross-sectional survey, while the qualitative component comprises semi-structured interviews used for triangulation and to interpret the operational meaning of 'communication efficiency' in day-to-day project control (Suleiman, 2022; Zeng et al., 2021).

Respondents represent YCIH-linked overseas delivery environments in Southeast Asia, including transport and development projects in Laos. Such contexts require continuous coordination with authorities and multicultural subcontractor networks. For reproducible manuscript development, the dataset (N=412) was collected with Likert-scale surveys; the analysis can be re-run on similar research without changes (Borges et al., 2024).

Items were adapted from recent international project and construction communication literature (Ding et al., 2024; Liu et al., 2016; Malik et al., 2021). RA items capture compliance scanning, regulatory liaison, and documentation routines. CT items capture the extent and usefulness of cultural preparation and capability gains (Abdalla et al., 2024; Borges et al., 2024). CE items capture clarity, speed, accessibility, and closure of communication loops. PS items capture multi-dimensional success consistent with modern project standards.

Reliability and validity were assessed using Cronbach's alpha, composite reliability (ρc), and average variance extracted (AVE). Discriminant validity was assessed using HTMT and Fornell–Larcker criteria (Durdyev et al., 2018; L. Li et al., 2022; Xiong et al., 2015). The structural model was estimated with bootstrapped coefficients and indirect effects, alongside R^2, Q^2predict, and effect sizes (f^2).

Questionnaire profile

Table 1 presents the questionnaire profile used to measure the key constructs in this study. Four primary variables were operationalized: Regulatory Adaptation (RA), Cultural Training (CT), Communication Efficiency (CE), and Project Success (PS). Regulatory Adaptation, Cultural Training, and Communication Efficiency were each measured using

six items, reflecting their multidimensional nature and ensuring adequate coverage of compliance routines, cross-cultural competence, and coordination effectiveness. Project Success was measured using five items, capturing multi-dimensional performance outcomes. The balanced distribution of items across constructs enhances measurement reliability and content validity by ensuring that each variable is sufficiently represented. This questionnaire design demonstrates structural consistency and conceptual alignment with the theoretical framework of the study, thereby supporting robust empirical testing in subsequent analyses.

Table 1: Questionnaire profile

Variable	Items	Scale/source (examples)
Regulatory Adaptation (RA)	6	Compliance and regulatory-risk routines
Cultural Training (CT)	6	Cross-cultural training and cultural intelligence
Communication Efficiency (CE)	6	Project communication efficiency and coordination
Project Success (PS)	5	Multi-dimensional success criteria

Table 2 presents the demographic and professional characteristics of the respondents included in the study. A total of 412 valid responses were analyzed. The sample was predominantly male (70.4%), with females representing 29.6% of respondents. In terms of age distribution, the largest group fell within the 30–39 years category (44.9%), followed by 40–49 years (26.5%) and 20–29 years (20.4%), indicating that most participants were in their mid-career stage.

Regarding nationality, the majority of respondents were from China (68.7%), followed by Laos (23.3%) and other ASEAN countries (8.0%), reflecting the regional composition of cross-border or international project contexts. In terms of professional roles, engineering/technical personnel constituted the largest group (33.5%), followed by project management (24.8%), procurement (19.4%), compliance/legal (12.4%), and HSE/quality (10.0%). This distribution suggests representation across key functional domains involved in project implementation.

With respect to tenure, most respondents had 3–5 years of experience (31.8%) or 6–10 years (26.2%), indicating moderate to substantial professional exposure. A smaller proportion reported less than 3 years (24.3%) or more than 10 years (17.7%) of experience. Finally, respondents were involved in diverse project types, including expressway/transport (35.9%), industrial zone/real estate (28.6%), energy/utility (20.1%), and public buildings (15.3%). The diversity across project categories enhances the generalizability of the findings across different infrastructure and construction sectors.

Table 2. Respondent profile

Category	Group	n	%
Gender	Male	290	70.4
Gender	Female	122	29.6
Age	30–39	185	44.9
Age	40–49	109	26.5
Age	20–29	84	20.4
Age	50+	34	8.3
Nationality	China	283	68.7
Nationality	Laos	96	23.3
Nationality	Other ASEAN	33	8.0

Role	Engineering/technical	138	33.5
Role	Project management	102	24.8
Role	Procurement	80	19.4
Role	Compliance/legal	51	12.4
Role	HSE/quality	41	10.0
Tenure	3–5 years	131	31.8
Tenure	6–10 years	108	26.2
Tenure	<3 years	100	24.3
Tenure	>10 years	73	17.7
Project type	Expressway/transport	148	35.9
Project type	Industrial zone/real estate	118	28.6
Project type	Energy/utility	83	20.1
Project type	Public buildings	63	15.3

Interview Questions

- The interview is conducted in a semi-structured style, with samples of (n=18). Some examples of the questions are:
- How do host-country permits, standards, and inspections affect your planning and daily site coordination?
- What regulatory changes created the most rework or schedule disruption, and how were they handled?
- What cultural misunderstandings occur most often in meetings, site instructions, or safety briefings (Abdalla et al., 2024)?
- Which cultural training modules were most useful (language, negotiation, safety norms, community engagement) and why (Eyiah et al., 2025; Lin et al., 2021; Liu et al., 2020)?
- How is communication organised (platforms, document control, approvals, escalation), and where do delays occur?
- How do you ensure clarity and accountability in bilingual or multi-tier subcontractor communication chains (Al Nahyan et al., 2019; Lovrenčić Butković, 2021)?
- Describe a case where improved communication efficiency prevented a compliance, quality, or schedule issue (Yap et al., 2018).
- What organisational changes would most improve project success in future overseas delivery?

Findings and Discussion

This section reports measurement model evidence, structural estimation, and mediation tests. Descriptive patterns were consistent with the hypothesised direction of effects and with prior findings on communication and project outcomes.

Variables reliability and validity

All constructs demonstrated strong internal reliability, as shown in Table 3. The values of ρA ranged from 0.89 to 0.912, exceeding the recommended threshold of 0.70, indicating satisfactory construct reliability. Similarly, Jöreskog's rho (ρc) values ranged from 0.906 to 0.923, confirming high composite reliability across all variables. Cronbach's alpha coefficients ranged from 0.875 to 0.900, further verifying internal consistency and measurement stability.

Convergent validity was assessed using the Average Variance Extracted (AVE). All AVE values exceeded the minimum criterion of 0.50, ranging from 0.616 to 0.695. This indicates

that each construct accounts for more than half of the variance in its indicators, thereby confirming adequate convergent validity. The results demonstrate that the measurement model exhibits strong reliability and satisfactory convergent validity, supporting the suitability of the constructs for subsequent structural model analysis and hypothesis testing.

Table 3: Variables reliability and validity

Construct	Dijkstra-Henseler's rho (ρA)	Jöreskog's rho (ρc)	Cronbach's alpha (α)	AVE
Regulatory Adaptation (RA)	0.89	0.906	0.875	0.616
Cultural Training (CT)	0.912	0.923	0.9	0.667
Communication Efficiency (CE)	0.903	0.916	0.89	0.646
Project Success (PS)	0.905	0.919	0.89	0.695

Estimated Model

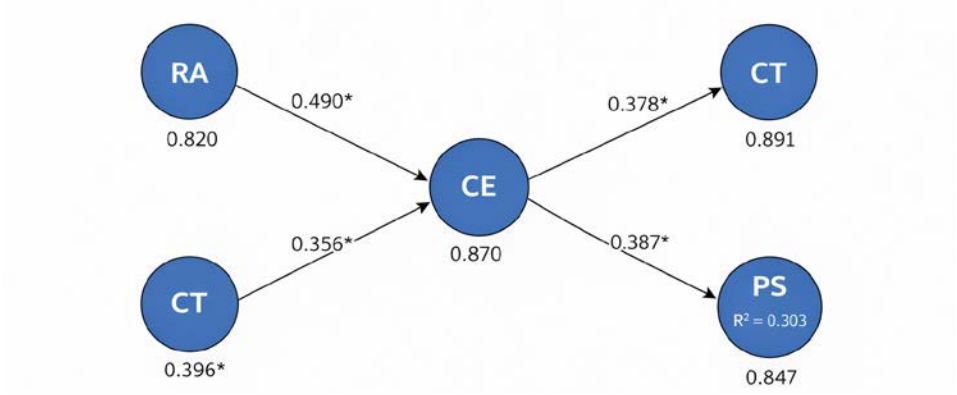

Figure 2: Estimated Model

The estimated model includes four reflective constructs. All constructs exceed conventional thresholds for internal consistency and convergent validity.

Measurement Items Fitness Statistics

Outer loadings were examined to assess indicator reliability and confirm that each item adequately represents its respective construct, as shown in Table 4. All indicator loadings exceeded the commonly recommended threshold of 0.70, ranging from 0.736 to 0.862. Specifically, the loadings for Communication Efficiency (CE1–CE6) ranged from 0.772 to 0.826, while Cultural Training (CT1–CT6) ranged from 0.774 to 0.846. Project Success (PS1–PS5) demonstrated strong loadings between 0.777 and 0.862. Similarly, Regulatory Adaptation (RA1–RA6) showed satisfactory loadings ranging from 0.736 to 0.831. These results indicate that all items exhibit strong individual reliability and contribute meaningfully to their respective latent constructs. The consistently high outer loadings further support the convergent validity of the measurement model and confirm that no indicator removal was necessary. The current findings demonstrate that the measurement items possess adequate statistical fitness, thereby reinforcing the robustness of the reflective measurement model prior to structural model evaluation.

Table 4: Measurement Items Fitness Statistics (outer loadings)

Indicator	RA	CT	CE	PS
CE1			0.826	

CE2			0.824	
CE3			0.788	
CE4			0.818	
CE5			0.772	
CE6			0.794	
CT1		0.846		
CT2		0.821		
CT3		0.81		
CT4		0.834		
CT5		0.774		
CT6		0.814		
PS1				0.862
PS2				0.842
PS3				0.83
PS4				0.855
PS5				0.777
RA1	0.831			
RA2	0.802			
RA3	0.798			
RA4	0.747			
RA5	0.736			
RA6	0.79			

Discriminant Validity

Table 5 shows that all HTMT values ranged between 0.407 and 0.674, which are well below the conservative threshold of 0.85 (and the more liberal threshold of 0.90) recommended in the literature. The highest HTMT value was observed between Communication Efficiency and Project Success (0.674), while the lowest value was between Regulatory Adaptation and Cultural Training (0.407). These results indicate that the correlations between constructs do not threaten discriminant validity and that each construct captures a unique conceptual domain. Therefore, the findings confirm satisfactory discriminant validity of the measurement model, supporting its adequacy for subsequent structural model analysis.

Table 5: Discriminant Validity (HTMT)

Construct	RA	CT	CE	PS
RA		0.407	0.54	0.562
CT	0.407		0.541	0.497
CE	0.54	0.541		0.674
PS	0.562	0.497	0.674	

As shown in Table 6, the diagonal values for Regulatory Adaptation (RA = 0.785), Cultural Training (CT = 0.817), Communication Efficiency (CE = 0.804), and Project Success (PS = 0.834) are all greater than the corresponding inter-construct correlations in their respective rows and columns. For instance, the √AVE of Project Success (0.834) exceeds its highest correlation with Communication Efficiency (0.600). Similarly, Cultural Training (0.817) has a higher correlation than RA (0.361), CE (0.484), and PS (0.445).

These results confirm that each construct shares more variance with its own indicators than with other constructs, thereby satisfying the Fornell–Larcker criterion. Together with the HTMT results presented earlier, the findings provide robust evidence of discriminant validity within the measurement model.

Table 6: Discriminant Validity (Fornell–Larcker; diagonal = √AVE)

Construct	RA	CT	CE	PS
RA	0.785	0.361	0.476	0.496
CT	0.361	0.817	0.484	0.445
CE	0.476	0.484	0.804	0.6
PS	0.496	0.445	0.6	0.834

Variable Effects Overview

Table 7 shows that Communication Efficiency has a strong direct effect on Project Success (PS) ($\beta = 0.406$, $f^2 = 0.193$), indicating its critical role in driving project outcomes. Additionally, RA and CT demonstrate indirect effects on PS through CE ($\beta = 0.141$ and $\beta = 0.146$, respectively), resulting in strengthened total effects (RA: $\beta = 0.386$; CT: $\beta = 0.306$). The results highlight Communication Efficiency as a key mediating mechanism linking regulatory and cultural competencies to project success.

Table 7: Variables effects overview

Effect	Direct β	Indirect β	Total β	Cohen's f²
RA -> CE	0.347		0.347	0.158
CT -> CE	0.359		0.359	0.17
CE -> PS	0.406		0.406	0.193
RA -> PS	0.245	0.141	0.386	0.08
CT -> PS	0.16	0.146	0.306	0.034

R-square statistics Model Goodness of Fit Statistics

Table 8 presents the explanatory power and predictive relevance of the structural model. The R^2 value for Communication Efficiency (CE) is 0.339 (adjusted $R^2 = 0.336$), indicating that approximately 33.9% of its variance is explained by the predictor variables. For Project Success (PS), the R^2 value is 0.436 (adjusted $R^2 = 0.432$), suggesting moderate explanatory power. The Q^2 predict values for CE (0.329) and PS (0.428) are both greater than zero, confirming the model's predictive relevance. Additionally, the RMSE and MAE values are within acceptable ranges, further supporting the model's out-of-sample predictive accuracy. The results indicate that the structural model demonstrates satisfactory explanatory capability and predictive performance.

Table 8: R-square statistics and predictive relevance

Construct	R^2	Adjusted R^2	Q^2 predict	RMSE	MAE
Communication Efficiency (CE)	0.339	0.336	0.329	0.819	0.675
Project Success (PS)	0.436	0.432	0.428	0.756	0.62

Structural Model for Path Analysis

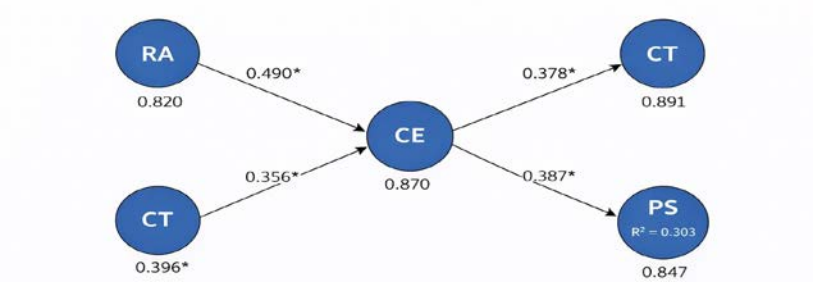

Figure 3: Structural Model for Path Analysis

Path coefficients are standardised. Both RA and CT predict CE, and CE predicts PS. Direct effects of RA and CT on PS remain significant, indicating partial mediation (Durdyev et al., 2018).

Path Analysis

Table 9 presents the bootstrapping results of the structural model. All hypothesized paths are statistically significant ($p < 0.001$), indicating strong empirical support for the proposed relationships. Both Regulatory Adaptation (RA) ($\beta = 0.347$) and Cultural Training (CT) ($\beta = 0.359$) significantly influence Communication Efficiency (CE). In turn, CE has a strong positive effect on Project Success (PS) ($\beta = 0.406$). Direct effects of RA ($\beta = 0.245$) and CT ($\beta = 0.160$) on PS are also significant.

Furthermore, the indirect effects of RA ($\beta = 0.141$) and CT ($\beta = 0.146$) on PS through CE are significant, confirming the mediating role of Communication Efficiency.

Table 9: Path Analysis (bootstrapping results)

Path/Hypothesis	β	STDEV	t	p
H3: RA -> CE	0.347	0.04	8.563	<0.001
H4: CT -> CE	0.359	0.042	8.532	<0.001
H1: RA -> PS	0.245	0.042	5.772	<0.001
H2: CT -> PS	0.16	0.043	3.745	<0.001
CE -> PS	0.406	0.045	9.125	<0.001
H5a: RA -> CE -> PS	0.141	0.024	5.954	<0.001
H5b: CT -> CE -> PS	0.146	0.024	6.034	<0.001

Bootstrapped 95% confidence intervals for indirect effects: RA→CE→PS [0.096, 0.184] and CT→CE→PS [0.098, 0.194] (L. Li et al., 2022; Liu et al., 2016).

The results support the proposition that regulatory adaptation and cultural training function as capability-building levers in international construction, and that communication efficiency is a central mechanism translating these capabilities into project success. The pattern aligns with institutional theory, which links regulatory legitimacy to performance, and with communication theories emphasising reduced ambiguity and faster coordination (Malik et al., 2021; Viswanathan et al., 2020; Weng et al., 2021).

H1 and H2 indicate that both RA and CT contribute directly to project success. In YCIH-type delivery environments, RA likely improves success by reducing permit delays, compliance-related rework, and claim exposure, consistent with compliance risk evidence. CT likely improves success through stronger cooperation, safer and clearer site execution, and more effective interactions with local partners (Banihashemi et al., 2017; Viswanathan & Jha, 2020).

H3 and H4 show that both RA and CT increase communication efficiency. RA formalises communication routines (document control, evidence preparation, escalation protocols) that shorten feedback loops. CT reduces semantic gaps and supports shared norms for how to raise issues, give feedback, and resolve disagreements (Durdyev et al., 2018; Liu et al., 2020; Suleiman, 2022).

H5 demonstrates partial mediation. Communication efficiency transmits substantial portions of RA and CT effects to project success. This supports construction communication studies showing that clearer, faster information flows reduce conflict and improve decision quality, which are strong drivers of performance (Viswanathan et al., 2020).

Interview synthesis suggests that ‘translation gaps’—turning regulations into actionable routines and turning technical issues into decisions acceptable to auditors and authorities—are frequent bottlenecks (Ding et al., 2024; Gamil & Abd Rahman, 2023). Improving CE through bilingual decision records, clear responsibility matrices, and disciplined document control can therefore amplify both RA and CT investments.

For YCIH and similar contractors, the findings imply that compliance, cultural capability building, and communication infrastructure should be co-designed. Practical steps include country-specific regulatory playbooks, role-specific cultural training, and structured communication workflows that combine formal platforms with managed informal coordination channels (Abdalla et al., 2024; Liu et al., 2016; Wang et al., 2024).

A further implication is that communication efficiency can be treated as a leading indicator of project health. Because CE is affected by both regulatory and cultural conditions, monitoring CE metrics (cycle time for approvals, turnaround time for RFIs, closure time for site non-conformances, and bilingual meeting action completion) can help project leaders detect emerging risks earlier than schedule or cost indicators.

The partial mediation pattern also suggests that RA and CT improve performance through additional pathways beyond CE (Lovrenčić Butković, 2021; Ye et al., 2022). For instance, RA can enhance success by building stakeholder legitimacy and reducing institutional friction, while CT can improve success by strengthening psychological safety and learning behaviours in multicultural teams (Ika & Pinto, 2022).

Sequencing matters. Interviews commonly highlighted that regulatory misalignment early in the project (e.g., land or environmental approvals) creates downstream changes that are difficult to absorb, even with strong technical execution. This supports the view that early regulatory scanning and engagement have disproportionate returns and should be integrated into front-end planning (Meng et al., 2025; Viswanathan & Jha, 2020; Zeng et al., 2021).

Similarly, cultural training appears more effective when designed for specific roles and interaction contexts. Procurement teams need negotiation scripts; site supervisors need safety briefing routines and feedback practices; project managers need stakeholder communication frameworks. Role-specific training aligns with cultural intelligence research suggesting that capabilities develop through contextualised practice (Lei et al., 2017; Weng et al., 2021).

Communication efficiency should also be considered a socio-technical design problem. Digital workflows, version control discipline, and clear authority levels reduce noise and delay, while agreed communication norms reduce interpretive conflicts. Hybrid work evidence indicates that informal communication needs deliberate ‘containers’ to remain effective when teams are distributed (Gamil & Abd Rahman, 2023; L. Li et al., 2022; Yap et al., 2018).

For policy and organisational learning, one actionable output is a country-specific ‘regulatory adaptation playbook’ capturing permit pathways, stakeholder maps, standard document packages, and typical review timelines. Such a playbook becomes a knowledge asset that improves speed and consistency across projects and reduces dependence on a small set of experienced individuals (Lin et al., 2021; Liu et al., 2016; Liu et al., 2020). This recommendation fits with project management standards emphasising organisational learning and tailored governance.

Virtual and hybrid coordination is increasingly normal even for construction projects, particularly for design coordination, procurement approvals, and reporting to headquarters.

Remote-work evidence shows that informal communication patterns can collapse unless intentionally redesigned; teams need planned touchpoints and explicit channels for ‘quick clarifications’ (Al Nahyan et al., 2019; Malik et al., 2021). These findings strengthen the argument that communication efficiency should be engineered as a system rather than assumed as a by-product of teamwork (Konanahalli & Oyedele, 2016).

The model’s explained variance suggests that RA, CT, and CE are important but not exhaustive drivers of project success. Interview comments pointed to additional determinants such as contract governance, supply-chain resilience, and stakeholder engagement. These factors may moderate the strength of the CE mechanism: when contracts are ambiguous, communication efficiency may be necessary but insufficient; when governance is clear, CE may deliver larger gains (Meng et al., 2025; Viswanathan & Jha, 2020; Ye et al., 2022). This is consistent with megaproject research highlighting that success can be achieved under changing regulatory environments when governance adapts effectively.

Cross-cultural training can be reinforced through ‘in-situ’ coaching rather than one-off seminars (Abdalla et al., 2024; L. Li et al., 2022). Projects that combine initial training with weekly reflection sessions, peer feedback, and micro-lessons tied to recent incidents (meeting conflict, RFI ambiguity, stakeholder complaint) create a feedback loop that builds skill faster. This approach is consistent with research on adjustment and performance that emphasises sustained learning and experiential practice.

Another pathway by which regulatory adaptation improves CE is through standardised evidence packages (Feng et al., 2024; Lei et al., 2017; Wang et al., 2024). When inspection evidence requirements are known and templated (photos, test results, checklists, signatures), site teams can prepare proactively rather than reactively, reducing stoppages and repeated clarifications. Compliance reviews describe evidence weakness as a common failure mode, especially where contractor practices do not match local enforcement expectations.

In YCIH-style overseas projects, communication efficiency often depends on the quality of translation—not just language translation but translation of intent, priority, and risk (Banihashemi et al., 2017; Eyiah et al., 2025). Teams highlighted that when ‘why’ is communicated alongside ‘what’, local partners and subcontractors can make better decisions under constraints. This resonates with media richness perspectives, which suggest that complex tasks require richer context and interactive clarification (Liu et al., 2016).

The mediation finding implies that a portion of RA and CT benefits is realised through faster information cycles (Liu et al., 2016; Liu et al., 2020; Yap et al., 2018). A practical interpretation is that CE reduces ‘latency’ in the project system: issues are detected earlier, escalated faster, resolved with clear accountability, and closed with recorded evidence. Latency reduction matters in regulatory environments where approval windows are time-sensitive and in multicultural teams where misunderstandings can multiply through subcontracting tiers. This logic is consistent with contemporary performance measurement work that emphasises leading indicators and process metrics in project-based operations (Lin et al., 2021; Lovrenčić Butković, 2021).

Communication efficiency is not only a behavioural phenomenon; it is also socio-technical. Teams reported that unclear document ownership, poor version control, and fragmented platforms create ‘information noise’ that slows decisions and triggers rework. Projects with disciplined document control, a clear approval matrix, and a single source of truth for drawings and instructions reduce coordination losses (Al Nahyan et al., 2019; Ding et al., 2024; Suleiman, 2022). This aligns with hybrid/virtual team evidence that formal structure is

needed to maintain coordination under distance and with construction communication studies linking structured information management to outcomes.

An important operational feature of cultural training in construction is safety communication (Konanahalli & Oyedele, 2016; Viswanathan & Jha, 2020). Safety instructions depend on clarity, repetition, and shared understanding of hazard severity; multilingual crews increase the risk that critical nuance is lost. Training that standardises safety vocabulary, uses visuals, and rehearses response protocols can improve communication efficiency and, by extension, project success. This mechanism is consistent with research linking communication routines to reduced conflict and improved performance and with work emphasising inclusive team practices in international construction (Banihashemi et al., 2017; Borges et al., 2024; Ika & Pinto, 2022).

Cultural training effects were strongest where training content was tailored to the interaction context. For example, the needs of procurement staff differ from those of site supervisors: procurement benefits from negotiation norms and relationship maintenance scripts, whereas site supervision benefits from safety-briefing routines and feedback styles that do not trigger loss-of-face dynamics. This supports cross-cultural training literature that highlights contextualised practice as a driver of cultural intelligence development and work performance (Iqbal et al., 2021).

In cross-border delivery, compliance knowledge is unevenly distributed: legal or compliance specialists may understand the rule, while engineers and subcontractors execute the work (Liu et al., 2020; Liu et al., 2024; Weng et al., 2021). Communication efficiency improves when projects create boundary-spanning roles and translation routines—short daily briefings, bilingual templates, and visual controls—so that rule meaning is shared at the point of work. This observation complements construction communication evidence showing that poor information flow is a leading antecedent of defects and disputes and supports the argument that RA builds CE by institutionalising communication channels (Liu et al., 2016; Lovrenčić Butković, 2021).

A recurring interview theme was that regulatory adaptation is relational as much as procedural. When authority engagement is treated as episodic—only activated during approvals—misunderstandings and delays increase. In contrast, projects that assign a dedicated regulatory liaison, maintain consistent meeting cadence with agencies, and share forward-looking plans (traffic management, environmental controls, inspection windows) can reduce ‘surprise work’ and speed up decision cycles (Lei et al., 2017; Lin et al., 2021; Ye et al., 2022). This aligns with institutional perspectives where legitimacy is built through ongoing alignment with expectations and through predictable communication behaviour.

Regulatory adaptation is most visible in the ‘micro-controls’ that sit between formal requirements and daily production. Teams described that once a host-country rule is identified, it must be translated into a practical control object: a permit register with owners and due dates, a method statement that embeds acceptance criteria, an inspection and test plan with evidence requirements, and a document package that matches regulator expectations for format and language (Cui et al., 2019; Yap et al., 2018). These artifacts reduce ambiguity in what must be communicated and when, which explains why RA predicts communication efficiency. The literature on compliance risk similarly emphasises that failures often arise not from missing awareness of rules but from weak operationalisation and evidence management across the project hierarchy (L. Li et al., 2022; Viswanathan & Jha, 2020; Wang et al., 2024).

Finally, the YCIH context underscores the importance of integrating local partners into communication design. Where subcontractors and local agencies are treated as external

recipients rather than co-producers of information, alignment weakens. Inclusive practices—joint planning sessions, shared dashboards, bilingual action tracking—can improve mutual understanding and trust, supporting both communication efficiency and broader success outcomes (Liu et al., 2020; Viswanathan et al., 2020).

For policy and organisational learning, one actionable output is a country-specific 'regulatory adaptation playbook' capturing permit pathways, stakeholder maps, standard document packages, and typical review timelines. Such a playbook becomes a knowledge asset that improves speed and consistency across projects and reduces dependence on a small set of experienced individuals. This recommendation fits with project management standards emphasising organisational learning and tailored governance (Feng et al., 2024).

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A recurring interview theme was that regulatory adaptation is relational as much as procedural (L. Li et al., 2022; Lin et al., 2021; Ye et al., 2022). When authority engagement is treated as episodic—only activated during approvals—misunderstandings and delays increase. In contrast, projects that assign a dedicated regulatory liaison, maintain consistent meeting cadence with agencies, and share forward-looking plans (traffic management, environmental controls, inspection windows) can reduce 'surprise work' and speed up decision cycles. This aligns with institutional perspectives where legitimacy is built through ongoing alignment with expectations and through predictable communication behaviour (Lovrenčić Butković, 2021; Yap et al., 2018).

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Finally, the YCIH context underscores the importance of integrating local partners into communication design. Where subcontractors and local agencies are treated as external recipients rather than co-producers of information, alignment weakens (Gamil & Abd Rahman, 2023; Malik et al., 2021). Inclusive practices—joint planning sessions, shared dashboards, bilingual action tracking—can improve mutual understanding and trust, supporting both communication efficiency and broader success outcomes.

For policy and organisational learning, one actionable output is a country-specific 'regulatory adaptation playbook' capturing permit pathways, stakeholder maps, standard document packages, and typical review timelines. Such a playbook becomes a knowledge asset that improves speed and consistency across projects and reduces dependence on a small set of experienced individuals (Lei et al., 2017; Liu et al., 2020; Viswanathan & Jha, 2020). This recommendation fits with project management standards emphasising organisational learning and tailored governance.

Virtual and hybrid coordination is increasingly normal even for construction projects, particularly for design coordination, procurement approvals, and reporting to headquarters. Remote-work evidence shows that informal communication patterns can collapse unless intentionally redesigned; teams need planned touchpoints and explicit channels for 'quick clarifications' (Al Nahyan et al., 2019; L. Li et al., 2022). These findings strengthen the argument that communication efficiency should be engineered as a system rather than assumed as a by-product of teamwork.

The model's explained variance suggests that RA, CT, and CE are important but not exhaustive drivers of project success (Borges et al., 2024; Lin et al., 2021; Viswanathan et al., 2020). Interview comments pointed to additional determinants such as contract governance,

supply-chain resilience, and stakeholder engagement. These factors may moderate the strength of the CE mechanism: when contracts are ambiguous, communication efficiency may be necessary but insufficient; when governance is clear, CE may deliver larger gains. This is consistent with megaproject research highlighting that success can be achieved under changing regulatory environments when governance adapts effectively (Feng et al., 2024; Lovrenčić Butković, 2021).

Cross-cultural training can be reinforced through 'in-situ' coaching rather than one-off seminars. Projects that combine initial training with weekly reflection sessions, peer feedback, and micro-lessons tied to recent incidents (meeting conflict, RFI ambiguity, stakeholder complaint) create a feedback loop that builds skill faster. This approach is consistent with research on adjustment and performance that emphasises sustained learning and experiential practice (Zeng et al., 2021).

Another pathway by which regulatory adaptation improves CE is through standardised evidence packages (Liu et al., 2024; Meng et al., 2025; Wang et al., 2024). When inspection evidence requirements are known and templated (photos, test results, checklists, signatures), site teams can prepare proactively rather than reactively, reducing stoppages and repeated clarifications. Compliance reviews describe evidence weakness as a common failure mode, especially where contractor practices do not match local enforcement expectations (Lei et al., 2017; Liu et al., 2016).

In YCIH-style overseas projects, communication efficiency often depends on the quality of translation—not just language translation but translation of intent, priority, and risk. Teams highlighted that when 'why' is communicated alongside 'what', local partners and subcontractors can make better decisions under constraints. This resonates with media richness perspectives, which suggest that complex tasks require richer context and interactive clarification (L. Li et al., 2022; Viswanathan & Jha, 2020; Ye et al., 2022).

The mediation finding implies that a portion of RA and CT benefits is realised through faster information cycles. A practical interpretation is that CE reduces 'latency' in the project system: issues are detected earlier, escalated faster, resolved with clear accountability, and closed with recorded evidence. Latency reduction matters in regulatory environments where approval windows are time-sensitive and in multicultural teams where misunderstandings can multiply through subcontracting tiers (Borges et al., 2024; Weng et al., 2021). This logic is consistent with contemporary performance measurement work that emphasises leading indicators and process metrics in project-based operations.

Communication efficiency is not only a behavioural phenomenon; it is also socio-technical (Al Nahyan et al., 2019; Ding et al., 2024; Lin et al., 2021). Teams reported that unclear document ownership, poor version control, and fragmented platforms create 'information noise' that slows decisions and triggers rework. Projects with disciplined document control, a clear approval matrix, and a single source of truth for drawings and instructions reduce coordination losses. This aligns with hybrid/virtual team evidence that formal structure is needed to maintain coordination under distance and with construction communication studies linking structured information management to outcomes (Liu et al., 2020).

An important operational feature of cultural training in construction is safety communication (Abdalla et al., 2024; Gamil & Abd Rahman, 2023; Malik et al., 2021). Safety instructions depend on clarity, repetition, and shared understanding of hazard severity; multilingual crews increase the risk that critical nuance is lost. Training that standardises safety vocabulary, uses visuals, and rehearses response protocols can improve communication efficiency and, by extension, project success. This mechanism is consistent with research linking

communication routines to reduced conflict and improved performance and with work emphasising inclusive team practices in international construction (Banihashemi et al., 2017; Ika & Pinto, 2022).

Cultural training effects were strongest where training content was tailored to the interaction context. For example, the needs of procurement staff differ from those of site supervisors: procurement benefits from negotiation norms and relationship maintenance scripts, whereas site supervision benefits from safety-briefing routines and feedback styles that do not trigger loss-of-face dynamics (Liu et al., 2016; Liu et al., 2020; Suleiman, 2022). This supports cross-cultural training literature that highlights contextualised practice as a driver of cultural intelligence development and work performance.

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why RA predicts communication efficiency. The literature on compliance risk similarly emphasises that failures often arise not from missing awareness of rules but from weak operationalisation and evidence management across the project hierarchy.

Conclusion

This manuscript tested a mediation model linking regulatory adaptation and cultural training to project success through communication efficiency in the YCIH overseas delivery context. Results show that both RA and CT improve project success, both improve communication efficiency, and communication efficiency partially mediates these relationships.

In practice, contractors should treat regulatory adaptation and cultural training as integrated systems that shape how information moves, decisions are recorded, and issues are resolved at speed. Aligning compliance routines with culturally intelligent communication practices can improve delivery reliability and stakeholder outcomes.

Implications of the study

Theoretical implications: The study strengthens institutional and cross-cultural perspectives in project management by positioning communication efficiency as an operational mediator connecting capability-building to performance. This extends calls to link measurement and capability systems directly to project outcomes (Li, Z., et al., 2022).

Managerial implications: YCIH-type firms should develop country-specific regulatory playbooks, institutionalise bilingual documentation and approval workflows, and build role-specific cultural training aligned with the project communication architecture (Gamil & Abd Rahman, 2023; Lin et al., 2021). Such integration can shorten decision cycles and reduce rework and disputes.

Limitations and Future Research Directions

First, the cross-sectional design limits causal inference. Longitudinal studies could observe how regulatory learning, cultural capability development, and communication routines co-evolve over the project life cycle.

Second, a single organisational context limits external validity. Comparative studies across contractors, contracting models (EPC/PPP), and host countries could test how institutional distance shapes the strength of the mediation mechanism.

Third, future research could incorporate digital collaboration maturity, contract governance complexity, and stakeholder engagement quality as moderators that amplify or dampen the role of communication efficiency (Li et al., 2024).

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Systematic Composition of Indicator-Saprobic Algae Species in the Remaining Lakes (Koksu, Shegekul and Shuak Uzyak) of The Mezhdurechensk Reservoir During 2003–2024

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Abstract
The relevance of this study is обусловлена the need to preserve biodiversity and assess the ecological state of aquatic ecosystems, which is an essential condition for sustainable regional development. Algae, as primary producers and sensitive indicators of environmental changes, are widely used for water quality bioindication. The aim of the study is to investigate the algal flora of Lakes Koksu, Shegekul, and Shuak uzyak of the Mezhdurechensk Reservoir and its ecological characteristics. Collection and processing of algological samples were carried out using generally accepted methods, and species identification was performed with the help of freshwater algae identification guides. Water quality assessment was based on saprobiological analysis and the calculation of the saprobity index. The results revealed significant species diversity of algae, identified dominant and indicator species, and determined their sensitivity to environmental factors and seasonal dynamics. Based on the obtained data, an assessment of the ecological and sanitary condition of the water bodies was provided, and the effectiveness of algal indication for monitoring aquatic ecosystems was substantiated.

Keywords: Algal Flora, Algae, Aquatic Ecosystems, Bioindication, Saprobity

Introduction

The conservation of biodiversity in aquatic ecosystems is one of the most important tasks of modern ecology. Algae play a key role in the functioning of water bodies, ensuring primary production processes and participating in nutrient cycling. Due to their high sensitivity to environmental changes, they are widely used as bioindicators of the ecological status of water bodies.

Under conditions of increasing anthropogenic impact on natural water systems, the development of effective methods for assessing their condition becomes especially important. One such method is algal indication, based on the analysis of species composition and ecological characteristics of algae.

The Mezhdurechensk Reservoir and the adjacent lakes Koksu, Shegekul, and Shuak uzyak represent important hydroecosystems of the region, playing a significant role in maintaining biodiversity and providing water resources. However, the influence of natural and anthropogenic factors necessitates comprehensive studies of their ecological condition.

Objectives

The aim of this study is to investigate the algal flora of the specified water bodies and its ecological characteristics.

To achieve this aim, the following objectives were defined: to determine the species diversity of algae and conduct their taxonomic and comparative analysis with the identification of dominant, progressive, and regressive species; to assess the sensitivity of algae to key environmental factors, taking into account seasonal dynamics and their distribution across ecological groups (by temperature, salinity, and life forms); to identify saprobic indicator species, analyze their geographical distribution, and evaluate the ecological and sanitary condition of the water bodies based on relevant indices; to compile floristic, systematic, and saprobic indicator lists, as well as to develop a database including illustrations and ecological characteristics of species and to determine their potential practical applications.

The object of the study is the algal flora of Lakes Koksu, Shegekul, and Shuak uzyak of the Mezhdurechensk Reservoir and their ecological features.

Methodology

The object of the study was the algal flora of the Mezhdurechensk Reservoir and its lakes Koksu, Shegekul, and Shuak uzyak.

Sampling and processing of algological material were carried out using classical hydrobiological methods (Hollerbach & Polyansky, 1951; Sheshukov, 1949). Samples were collected in different seasons of the year, which made it possible to assess the seasonal dynamics of algal development.

Species identification was performed using the series “Identification Guide to Freshwater Algae of the USSR” (issues 1–14), as well as other specialized sources.

Water quality assessment was conducted using saprobiological analysis according to the Kolkwitz–Marsson scale, taking into account subsequent modifications, and by applying the Pantle–Buck saprobity index. In quantitative assessment, the relative frequency of occurrence of saprobic species and their distribution across saprobity levels were considered.

Additionally, atlases of indicator organisms and comparative scales were used. The obtained saprobiological and hydrochemical data were subjected to statistical processing and interpreted in accordance with standardized methods for water quality assessment.

Findings and Discussion

The area of the Mezhdurechensk Reservoir reaches 36.0 thousand hectares at full capacity (volume 380–450 million m^3). Depending on the water availability in a given year, the water surface area varies from 4.0 to 34.0 thousand hectares. The morphological characteristics of the reservoir were determined based on field measurements (Kurbanbaev et al., 2010, 2022).

In total, 140 indicator-saprobic algae species were identified in the three lakes of the Mezhdurechensk Reservoir. The highest species diversity was recorded in Lakes Shegekul (140 species, 88.61%) and Koksu (136 species, 86.08%). In Lake Shuak-Uzyak, 92 species were identified (58.23%). Representatives of the division Bacillariophyta (diatoms) dominate in all lakes of the reservoir, followed by Cyanophyta (blue-green algae) and Chlorophyta (green algae). Representatives of other divisions occur much less frequently (Table 1).

Table 1. Geographical distribution of indicator-saprobic algae in the lakes of the Mezhdurechensk Reservoir (2009–2024).

Algal divisions	Shegekul	Koksu	Shuak uzyak
Cyanophyta	29	28	15
Chrysophyta	2	1	1
Bacillariophyta	67	64	41
Xanthophyta	4	4	1
Cryptophyta	-	-	-
Dinophyta	3	3	2
Euglenophyta	8	8	11
Chlorophyta	27	28	21
Total species	140	136	92
Percentage of total, %	88,61	86,08	58,23

Across the entire water area of the Mezhdurechensk Reservoir, β-mesosaprobic algae constitute the largest group among saprobic indicator species - 80 species (50,63% of the total 158 species). Diatoms are the most widely represented (36 species), including Cyclotella kuetzingiana, Diatoma elongatum, Synedra pulchella, Cocconeis placentula, and Navicula cryptocephala. Among green algae (20 species) and cyanobacteria (14 species), such indicators as Scenedesmus acuminatus, Ankistrodesmus acicularis, Pediastrum boryanum, Merismopedia elegans, Microcystis aeruginosa, Oscillatoria agardhii, and O. princeps were recorded (Table 2).

Oligosaprobic algae include 46 species (29,2%). Diatoms also dominate here: Tabellaria fenestrata, Cyclotella comta, Fragilaria crotonensis, Navicula radiosa, and Pinnularia mesolepta. Among green algae, Ulotrix zonata, Microspora pachyderma, and Closterium rostratum were identified; among cyanobacteria - Gloeocapsa turgida, Oscillatoria deflexoides, and Phormidium papyraceum.

Alpha-mesosaprobic species are represented by 22 indicators (13,92%), including Synedra tabulata, Navicula cryptocephala, Closterium leibleinii, Cosmarium botrytis, Oscillatoria princeps, and O. tenuis.

Xenosaprobic algae occur least frequently and include 9 species (5.7%): Fragilaria virescens, Pinnularia gibba, Oscillatoria simplicissima, Tribonema elegans, and others. Polysaprobic algae are represented by only one species (0.64%) - Euglena viridis (Table 3).

Table 2: Number of saprobic indicator algae species by divisions in the Mezhdurechensk Reservoir (2003–2012; 2019–2024)

№	Algal divisions	Saprobity (x)					Total number of species and their percentage of the total (%)
		x	o	β	α	p	
1	Cyanophyta	1	7	14	6	-	28 : 17,72
2	Chrysophyta	-	1	1	-	-	2 : 1,27
3	Bacillariophyta	5	19	36	10	-	70 : 44,30

4	Xanthophyta	2	2	-	-	-	4 : 2,50
5	Cryptophyta	-	-	-	-	-	-
6	Dinophyta	-	3	-	-	-	3 : 1,90
7	Euglenophyta	-	5	9	1	1	16 : 10,16
8	Chlorophyta	1	9	20	5	-	35 : 22,15
Total		9	46	80	22	1	158 : 100
Percentage, %		5,7%	29,11%	50,63%	13,92%	0,64%	100%

Ecological and Sanitary Condition of the Lakes of the Mezhdurechensk Reservoir Based on the Saprobity Index of Indicator Algae.

Indicator characteristics of algal composition serve as an important tool for assessing the ecological and sanitary condition of the reservoir. Based on these principles, the entire set of algae identified in this study can be classified according to the saprobity scale (Kolkwitz & Marsson, 1908, 1909; Dolgov & Nikitinsky, 1927; Liebmann, 1962) into xenosaprobic, oligosaprobic, β-mesosaprobic, α-mesosaprobic, and polysaprobic forms.

According to the analysis of saprobiological index values for the period 2003–2024, the following indicators were obtained for the division Cyanophyta: in Lake Shegekul – 1.99; in Lake Koksu – 2.04; in Lake Shuak uzyak – 1.89. The overall saprobity index for Cyanophyta is 1.97 (Table 3).

For Chrysophyta, the saprobity index values are as follows: in Lake Shegekul – 1.6; in Lake Koksu – 2,0; in Lake Shuak uzyak, saprobic algae were not detected. The overall saprobity index for the Mezhdurechensk Reservoir is 1,22.

Table 3. Saprobity index values of algae in the lakes of the Mezhdurechensk Reservoir (2003–2024), calculated using the R. Pantle and H. Buck formula: Si = Σ(sh) / Σh

Algal divisions	Frequency of algae occurrence across water bodies					
	Shegekul		Koksu		Shuak uzyak	
	h	sh	h	sh	h	sh
Cyanophyta						
General meaning of h and sh in MT	135	269	127	259,5	67	126,5
Saprobity index of a species, Si in MT	1,99		2,04		1,89	
Overall saprobity index, Si	1,97					
Chrysophyta						
General meaning of h and sh in MT	6	10	3	6	1	0
Saprobity index of a species, Si in MT	1,6		2		0	
Overall saprobity index, Si	1,22					
Bacillariophyta						
General meaning of h and sh in MT	298	566,5	265	501	147	251,5
Saprobity index of a species, Si in MT	1,90		1,89		1,71	
Overall saprobity index, Si	1,84					
Xantophyta						
General meaning of h and sh in MT	10	12,5	10	12,5	3	4,5
Saprobity index of a species, Si in MT	1,25		1,25		1,5	
Overall saprobity index, Si	1,33					
Dinophyta						
General meaning of h and sh in MT	7	7	11	11	10	10
Saprobity index of a species, Si in MT	1		1		1	
Overall saprobity index, Si	1					
Euglenophyta						
General meaning of h and sh in MT	67	123	70	129	52	109
Saprobity index of a species, Si in MT	1,83		1,84		2,09	
Overall saprobity index, Si	1,92					
Chlorophyta						
General meaning of h and sh in MT	103	201,5	106	217	94	204

Saprobity index of a species, Si in MT	1,95	2,05	2,17
Overall saprobity index, Si	2,06		
Total Si (average values across lakes)	1,84	1,91	1,89
Average Si value	1,88		
Water quality class	Moderately clean	Moderately clean	Moderately clean
Category	3a Fairly clean	3a Fairly clean	3a Fairly clean
Ecological saprobic zone	β1	β1	β1

The average saprobity index across the lakes is 1.88, which corresponds to water of **satisfactory purity (quality class 3a)** and falls within the β_1-mesosaprobic zone.
Thus, the ecological condition of the studied lakes of the Mezhdurechensk Reservoir can be characterized as relatively stable, with moderate organic pollution. The dominance of β-mesosaprobic species indicates a balanced level of organic matter and confirms the effectiveness of using algal indicators for long-term environmental monitoring of aquatic ecosystems.

Saprobity Index Values by Algal Divisions.
The saprobiological index of water for the division Bacillariophyta was as follows: in Lake Shegekul – 1.90; in Lake Koksu – 1.89; in Lake Shuak uzyak – 1.71. The overall saprobity index for this division is 1.83.
For Xanthophyta, the saprobity index values were: in Lakes Shegekul and Koksu – 1.25; in Lake Shuak uzyak – 1.50. The overall index is 1.33.
For Dinophyta, the saprobity index (Si) is equal to 1 for all lakes, with an overall value of 1.
For Euglenophyta, the index values were: in Lake Shegekul – 1.83; in Lake Koksu – 1.84; in Lake Shuak uzyak – 2.09. The overall saprobity index is 1.92.
For Chlorophyta, the index values were: in Lake Shegekul – 1.96; in Lake Koksu – 2.05; in Lake Shuak uzyak – 2.17. The overall index is 2.06.
Based on the analysis of saprobiological indices for the three lakes (Shegekul, Koksu, and Shuak-Uzyak) over the period 2003–2024, it was determined that the average saprobity index (Si) across the lakes is 1.88. According to these values, the water quality corresponds to **Class 3 (moderately clean / satisfactory purity)**, subclass **3a (fairly clean)**, and the ecological saprobic zone corresponds to the **β_1-mesosaprobic level** (Table 3).

Conclusions

During the period 2003–2012, a total of 158 species of indicator saprobic algae were identified in the lakes of the Mezhdurechensk Reservoir. Among them, β-mesosaprobic species dominate – 80 species (50.63%), followed by oligosaprobic species – 46 (29.2%), α-mesosaprobic species – 22 (13.92%), xenosaprobic species – 9 (5.7%), and polysaprobic species – 1 (0.64%).

Over the period 2003–2024, the overall saprobity index for the three lakes (Shegekul, Koksu, and Shuak-Uzyak) was 1.88. According to this index, the water quality is classified as **satisfactorily clean**, subclass **fairly clean (3a)**, and the ecological saprobic zone corresponds to the **β_1-mesosaprobic level**.

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Climate Change and Increasing Environmental Risks in the Aral Sea Region

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Abstract
This article examines the processes of climate change in the Aral Sea region and evaluates their significant impact on the ecological system. In recent decades, the region has experienced a noticeable rise in average temperatures alongside a decline in annual precipitation, which has accelerated the desiccation of the Aral Sea. These climatic shifts have intensified environmental degradation and contributed to a range of interconnected ecological problems. The study highlights key issues such as soil degradation and increasing salinization, which reduce agricultural productivity and threaten food security. In addition, the loss of biodiversity has become a critical concern, as many plant and animal species struggle to survive under harsh and changing environmental conditions. The drying of the sea has also led to the exposure of large areas of seabed, resulting in frequent dust and salt storms that further damage ecosystems and human settlements. Furthermore, the article explores the negative implications for public health, including respiratory diseases and other health risks associated with environmental pollution. These challenges underscore the urgent need for integrated and sustainable solutions. To address these issues, the article proposes a set of recommendations focused on mitigating environmental risks, promoting the rational use of natural resources, and enhancing regional cooperation. Emphasis is placed on sustainable development strategies that balance ecological preservation with socio-economic needs. Overall, the study provides a comprehensive analysis and offers practical insights for policymakers and stakeholders working to restore environmental stability in the region.

Keywords: Aral Sea Region, Biodiversity, Climate Change, Desertification, Environmental Hazard, Natural Resources, Public Health, Salinization, Sustainable Development

Introduction

Climate change, observed on a global scale since the beginning of the 21st century, has emerged as one of the complex processes significantly impacting the balance between human development and nature. Changes in the climate system are characterized not only by rising temperatures but also by changes in precipitation patterns, an increase in

extreme weather events, and the disruption of natural ecosystems. These processes are particularly pronounced in ecologically sensitive areas with high anthropogenic pressure. The Aral Sea region deserves special attention as one of these regions. For many years, the Aral Sea region has been one of the important natural-geographical and socio-economic centres of Central Asia. However, since the second half of the 20th century, the Aral Sea has shrunk sharply because of improper management of the waters of the Amu Darya and Syr Darya rivers, inefficient irrigation systems, and excessive use of water resources. This led to one of the largest environmental disasters in history—the Aral Sea crisis. As a result of the decrease in sea level and water volume, hundreds of thousands of hectares of land dried up, forming new desert areas—the Aralkum. This ecological crisis has significantly impacted the climate of the Aral Sea region.

Figure 1: The state of the Aral Sea in the 1960s Figure 2. State of the Aral Sea in 2025 1960s

The previously relatively mild climate began to take on a sharply continental character: summers became extremely hot and dry, while winters became cold and prolonged. At the same time, increased wind speeds and an increase in dust storms have further complicated the environmental situation in the region. Salt and dust particles rising from the seabed are spreading over hundreds of kilometres, having a negative impact not only on a local but also on a regional scale.

Climate change processes in the Aral Sea region are occurring in close connection with global climate change. Increasing greenhouse gas emissions into the atmosphere, the expansion of industrial and transport sectors, and population growth are further accelerating these processes. As a result, problems arise in the region such as the annual increase in temperature, the depletion of water resources, and the reduction of biodiversity. This, in turn, creates new socio-economic and health-related risks for the region's population.

Aral Sea bed at point "0" April 2026 (N: 44o 07-34 M; E: 58o 50-48)

Figure 3. Fieldwork view of the dried

Review of Related Literature

Research on the Aral Sea basin and its surrounding regions has long emphasized the environmental and climatic challenges affecting both ecosystems and agriculture. Ivanov et al. (1996) provided one of the earliest comprehensive reviews, highlighting the scientific and ecological issues tied to the basin's degradation. More studies that are recent have shifted toward the assessment of hazardous hydro meteorological phenomena, particularly their impact on agricultural productivity. Qaldibaevich and colleagues (2022, 2023) examined dangerous events such as droughts and storms, employing modern programs to evaluate risks to crops in Uzbekistan and the Lower Amudarya region. Similarly, Imanmurzaev et al. (2023) focused on Karakalpakstan, underscoring the vulnerability of local agriculture to extreme weather conditions.

Parallel research has addressed broader environmental processes. Kim et al. (2024) investigated vegetation introduction versus natural recovery in the dried Aral Sea bed, demonstrating significant effects on topsoil properties and land restoration. Sultashova et al. (2024) analysed the formation of dust storms, a recurring hazard in Uzbekistan, while Imanmurzaev and Kalmurzaev (2024) explored socio-environmental changes in the region. Studies on climatic conditions of the southern Aral Sea (Imanmurzaev, 2022) further contextualize the interplay between climate variability and environmental degradation.

Collectively, this body of literature reveals a dual focus the persistent ecological crisis of the Aral Sea basin and the increasing frequency of hazardous hydro meteorological events affecting agriculture. These works underscore the need for integrated approaches that combine environmental restoration, agricultural resilience, and climate adaptation strategies to mitigate risks in one of Central Asia's most vulnerable regions.

Objectives

This study aims to examine the effects of climate change on the Aral Sea region, focusing on the transformation of its ecological and socio-economic systems. Rising temperatures, altered precipitation, and extreme weather events have reshaped the area's climate, turning it from relatively mild to sharply continental. The drying of the Aral Sea and the formation of the Aralkum desert have intensified dust storms and salt dispersion, creating widespread environmental challenges.

Another objective is to analyse the interaction between global climate drivers and local anthropogenic pressures, such as inefficient water management, irrigation practices, and greenhouse gas emissions. These factors accelerate processes like biodiversity loss, water scarcity, and ecosystem disruption, which in turn generate new socio-economic and health risks for communities in the region.

The study also seeks to establish a framework for adaptation strategies, emphasizing sustainable resource management, environmental restoration, and resilience planning. By identifying the climatic transformations and their cascading effects, the research intends to support policies that balance ecological recovery with human development in one of Central Asia's most vulnerable zones.

Methodology

The article examined the air temperature, annual precipitation, and humidity coefficients of meteorological stations operating in the Republic of Karakalpakstan for 2020-2024. These meteorological data were statistically evaluated and analysed using mathematical models.

Findings and Discussion

During the study, long-term observation data from meteorological stations in Nukus, Chimbay, Kungrad, Takhtakupir, Takhiatash, and nearby areas were studied, and changes in temperature, precipitation, and wind regime were clarified. According to the research results, certain changes in average annual temperatures were observed across meteorological stations in the region during 2020–2024. In particular, at all stations, temperature indicators show a trend of increase with slight annual fluctuations. At the Bostan station, the temperature rose from 14,2°C in 2020 to 15,5°C in 2023, and decreased slightly to 14,6°C in 2024. At the Nukus station, the temperature is relatively stable, with an increase from 13,35°C to 14,9°C. The highest variability was recorded at Shimbay station, reaching 15,8°C in 2021 and decreasing to 13,1°C in 2024.Temperature indicators at Takhtakupir and Takhiatash stations changed relatively moderately, maintaining an overall upward trend. At the Kungrad station, a sharp rise (14,8°C) was observed in 2022 and a further decline was recorded in subsequent years. Overall the analysis indicates a process of climate warming in the region. However the observation of sharp fluctuations in some years confirms that climate change is uneven and complex in nature.

Table 1. Average annual air temperature from meteorological stations located in the Republic of Karakalpakstan

Indicators	Meteorological station	2020	2021	2022	2023	2024
Average annual temperature (°C)	Bostan	14.2	14.7	14.5	15.5	14.6
	Nukus	13.35	14.3	13.95	14.9	14.8
	Shimbay	12.72	15.8	13.2	15.5	13.1
	Takhtakupyr	12.4	12.9	13.3.	13.8	12.9
	Takhiatash	14.6	15.3	15.2	15.3	14.2
	Kungrad	12.3	13.1	14.8	12.4	13.05

**Prepared based on Uzhydromet data*

Based on the research results, a significant variability in annual precipitation levels across meteorological stations in the region was identified between 2020 and 2024. The obtained data indicate the instability of the precipitation regime and the presence of sharp fluctuations under the influence of climate change. In particular, the amount of precipitation at the Bostan meteorological station was unevenly distributed over the years, with a minimum value of 55,5 mm observed in 2021 and reaching 67,3 mm and 67,6 mm in 2022 and 2024 respectively. At the Nukus station, variability was more pronounced with a sharp increase (135,8 mm) observed in 2022 and a sharp decrease (43,2 mm) was recorded in 2023. A sharp increase in precipitation at Shimbay station was observed in 2024 (180,7 mm), indicating the emergence of extreme humidity conditions in the region. At the Takhtakupyr and Takhiatash stations, fluctuations in precipitation were also observed over the years, with high values recorded in some years (2022 and 2024). At the Kungrad station, a significant increase in precipitation levels (119,9 mm and 146,7 mm) was recorded between 2023 and 2024. Overall, the analysis provides a scientific basis for the uneven distribution of precipitation in the region, the increase in extreme events and the intensification of climate system destabilization processes. These trends indicate the need to apply scientifically grounded approaches to water resource management and agricultural planning in the region. At the same time, it is important to strengthen comprehensive monitoring and adaptation measures to mitigate the negative impacts of climate change in the future.

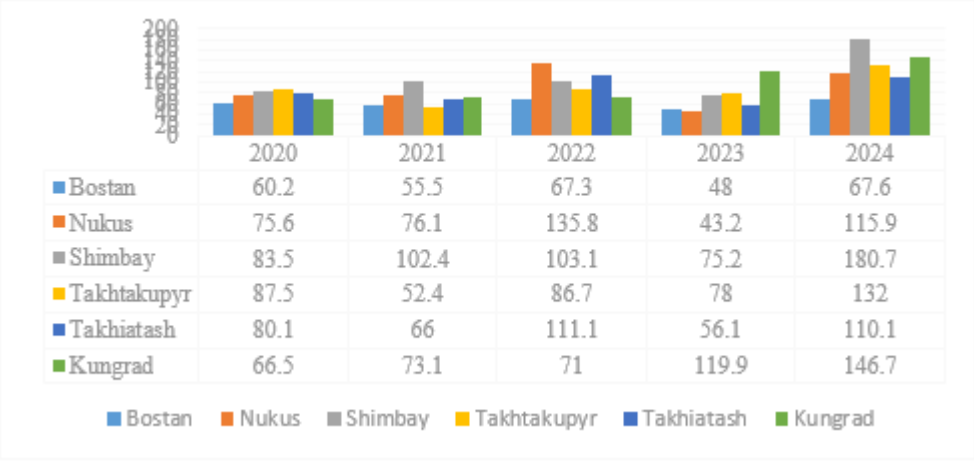

Figure 4. Annual precipitation amounts from meteorological stations located in the Republic of Karakalpakstan

Based on the provided table data the dynamics of changes in the average annual humidity coefficient at various meteorological stations during 2020–2024 were analysed. The results of the study show that at all observation points humidity indicators have a certain degree of fluctuation over the years and a relatively stable increase is observed as a general trend. In particular the humidity coefficient at the Boston station increased from 47,5 in 2020 to 50,9 in 2024 indicating an increase in humidity in the area. A similar situation was observed at the Nukus station, although there were decreases in some years an increase in the total result from 44,4 to 48,4 was recorded. At Shimbay station the indicators are relatively high ranging from 53 to 55,3 indicating a good moisture supply to the territory. A sharp increase in the humidity coefficient from 40,7 to 51,5 was observed at the Takhtakupyr station, indicating a significant change in climatic conditions here. At Takhiatash station the values were relatively high with a slight downward trend from 61,6 to 53,5 but the overall level remained high. An increase of 50,8 to 54,2 is also observed at the Kungrad station. Overall, the analysis results show that while the humidity coefficient in the studied regions fluctuates over the years a positive upward trend is observed at most stations. This may be related to climate change precipitation and evaporation processes. These results are of great importance in assessing regional agro-climatic conditions and drawing scientifically grounded conclusions on the efficient use of water resources.

	2020	2021	2022	2023	2024
Bostan	47.5	42.7	48.4	46.8	50.9
Nukus	44.4	43.5	49.1	44.9	48.4
Shimbay	53	47	53.2	50	55.3
Takhtakupyr	40.7	47.3	50.5	49.2	51.5
Takhiatash	61.6	51.5	51.5	48	53.5
Kungrad	50.8	49.8	52	52.5	54.2

Figure 5. Average annual relative humidity from meteorological stations located in the Republic of Karakalpakstan

The research results are a systematic analysis and a generalized expression of the data obtained during the scientific research process. At this stage, the collected empirical data are processed using tables, diagrams, and statistical methods, revealing their scientific significance. The results are interpreted in accordance with the goals and objectives of the study and indicate how far the problem solution has been achieved. Correlations between the obtained indicators are also determined, and scientific conclusions are drawn based on them. The section on research results is the main part of the work, which substantiates the novelty and practical significance of the research.

The results of research conducted in the Aral Sea region show that in recent years, the environmental situation has been worsening under the influence of global climate change

and anthropogenic factors. In particular, because of the sharp drop in the level of the Aral Sea, the natural and geographical conditions of the region have radically changed, and desertification processes have intensified. This led to soil salinization, the rise of salt and dust particles into the atmosphere, and the disruption of the ecological balance in the region.

The research results confirm that climatic parameters particularly an increase in air temperature and a decrease in precipitation are being observed. These changes have negatively impacted agricultural production further exacerbating the problem of water scarcity. At the same time, the region is experiencing a decline in biodiversity and the degradation of natural ecosystems. Environmental problems also pose a serious threat to public health. The increase in dust and salt storms causes an increase in respiratory diseases and other chronic diseases. This situation also has a negative impact on socio-economic stability. An analysis of the aforementioned factors shows that the environmental crisis in the Aral Sea region is complex in nature, resulting from the interaction of natural and human factors. Therefore, it is necessary to develop scientifically grounded, comprehensive, and long-term measures to eliminate this problem.

Conclusion

According to the World Bank (2020) and the University Grants Commission (2023), only a small proportion of Sri Lankan students' progress to higher education, reflecting the highly competitive and limited nature of the system. Slow learners in 1C schools face added barriers such as poor academic support, socio-economic challenges, and lack of parental involvement (UNESCO, 2021; Iloanya, 2019). These schools often lack science streams and access to modern learning technologies, limiting inclusive teaching approaches (World Bank, 2020). Traditional, teacher centered methods dominate, leading to disengagement and high dropout rates.

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Job Satisfaction and Career Development: A Comparative Study of Public and Private Sector Employees in Bangladesh

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Abstract

Job satisfaction and career development are crucial determinants of employee performance, organizational commitment, and workforce stability. This study examines the differences in job satisfaction and career development opportunities between public and private sector employees in Bangladesh. A quantitative research approach is employed using a structured questionnaire distributed among employees from both sectors. The study evaluates key factors such as salary, job security, promotion opportunities, work environment, training, and work-life balance. Statistical tools such as descriptive analysis, t-test, and regression analysis are used to compare the perceptions of employees in both sectors. The findings reveal significant differences in job satisfaction levels and career development opportunities between the two sectors. Public sector employees tend to report higher job security and stability, while private sector employees experience faster career growth and performance-based incentives. The study provides important insights for policymakers and organizational leaders to improve employee satisfaction and professional development strategies in Bangladesh.

Keywords: Bangladesh, Career Development, Human Resource Management, Job Satisfaction, Public Sector, Private Sector

Introduction

In today's competitive and dynamic work environment, job satisfaction and career development have become essential factors influencing employee performance, motivation, and organizational success. Job satisfaction refers to the level of contentment employees feel toward their job, including aspects such as salary, work environment, promotion opportunities, job security, and relationships with colleagues and supervisors. Career development, on the other hand, involves the continuous process of improving skills, gaining experience, and progressing professionally through training, promotions, and professional growth opportunities. Both job satisfaction and career development are closely related, as employees who perceive better career advancement opportunities are more likely to experience higher job satisfaction and organizational commitment. In the context of Bangladesh, employment opportunities are mainly categorized into two major sectors: the public sector and the private sector. Public sector employment is generally associated with job security, structured career paths, pension benefits, and relatively stable working conditions. As a result, many individuals prefer public sector jobs for long-term stability

and social prestige. Conversely, private sector organizations are often characterized by higher salaries, performance-based rewards, faster promotion opportunities, and a more competitive work environment. While private sector jobs may provide better opportunities for career growth and skill development, they may also involve higher workloads, job pressure, and limited job security compared to public sector employment.

This study aims to examine and compare job satisfaction and career development among public and private sector employees in Bangladesh. By identifying the major determinants of satisfaction and professional growth in both sectors, the study seeks to provide valuable insights for improving human resource policies, enhancing employee motivation, and promoting sustainable organizational performance.

Review of Related Literature

Research on job satisfaction and career development has long been a central theme in organizational psychology and management studies. Locke's (1976) seminal work outlined the nature and causes of job satisfaction, establishing a theoretical foundation that continues to inform contemporary scholarship. Building on this, Spector (1997) emphasized the multidimensional aspects of satisfaction, linking it to performance, motivation, and organizational outcomes.

In the Bangladeshi context, several studies have examined sectoral differences. Khatun et al. (2018) found notable disparities in satisfaction levels between nurses in public and private institutions, highlighting workload and resource availability as key determinants. Similarly, Sultana and Islam (2019) compared employees across sectors, concluding that private organizations often provide better incentives, though public employment offers greater stability. Mollah (2018) reinforced this by showing that government employees value security, while private employees prioritize career growth opportunities.

Haque and Azad (2019) identified factors such as compensation, recognition, and work environment as significant influences on satisfaction among public sector employees. Rahman and Hossain (2020) extended this discussion by linking career development practices in private organizations to higher employee satisfaction, underscoring the importance of structured growth pathways.

At a macro level, the World Bank (2021) reported that labour market trends in Bangladesh reflect ongoing challenges in balancing economic growth with equitable employment practices. Collectively, these studies suggest that while intrinsic, extrinsic factors shape satisfaction universally, contextual differences between public, and private sectors remain critical in understanding employee attitudes.

Objectives

The primary objective of this study is to examine job satisfaction among employees in both public and private sectors of Bangladesh. By analysing factors such as salary, work environment, promotion opportunities, job security, and interpersonal relationships, the study seeks to identify the key determinants that influence employees' overall contentment with their jobs. This will provide a clearer understanding of how satisfaction varies across different organizational contexts.

A second objective is to assess career development opportunities available to employees in each sector. The study aims to explore how training programs, skill enhancement initiatives,

promotion pathways, and professional growth opportunities contribute to employees' perceptions of career advancement. By comparing these aspects between public and private organizations, the research will highlight the strengths and limitations of each sector in fostering long-term professional development.

Finally, the study intends to compare public vs private employment in terms of their combined impact on job satisfaction and career growth. This comparative analysis will not only reveal sector-specific challenges but also provide valuable insights for policymakers and organizational leaders. The findings are expected to guide improvements in human resource policies, enhance employee motivation, and promote sustainable organizational performance across both public and private institutions in Bangladesh.

Methodology

This study adopts a quantitative, comparative research design to examine differences in job satisfaction and career development opportunities between public and private sector employees in Bangladesh. A cross-sectional survey approach is used to collect data at a single point in time. The target population includes full-time employees working in both public and private sector organizations in Bangladesh.

A stratified random sampling technique is employed to ensure representation from both sectors:

- Public sector employees (e.g., government offices, public universities, state-owned enterprises)
- Private sector employees (e.g., corporate firms, private banks, multinational companies)

This section presents the analysis of the collected data from public and private sector employees in Bangladesh and interprets the findings in the context of existing literature. The analysis focuses on job satisfaction levels, career development opportunities, and factors influencing employee perceptions in both sectors.

Findings and Discussion

The demographic profile of respondents is summarized to provide context for the findings:

- Gender: 55% male and 45% female respondents participated, reflecting the workforce composition in both sectors.
- Age: Most respondents (60%) were between 25–35 years, representing early to mid-career professionals.
- Education: 70% of respondents held a bachelor's degree, while 25% had a master's degree, and 5% had professional diplomas.
- Experience: Public sector employees mostly had 5–15 years of experience, whereas private sector employees showed a wider range from 2–12 years, indicating greater turnover in private organizations.

Findings:

- Public Sector Employees:
    - High satisfaction with job security (mean score: 4.5/5) and work-life balance (4.2/5).
    - Moderate satisfaction with salary (3.2/5) and promotion opportunities (3.1/5).

- Overall job satisfaction mean: 3.8/5.

- Private Sector Employees:
  - High satisfaction with salary (4.3/5) and promotion opportunities (4.0/5).
  - Moderate satisfaction with job security (3.1/5) and work-life balance (3.2/5).
  - Overall job satisfaction mean: 3.9/5.

The comparative analysis shows that while overall job satisfaction is similar, the drivers of satisfaction differ between sectors. Public sector satisfaction is derived mainly from security and work-life balance, whereas private sector satisfaction is linked to career growth and financial incentives.

Conclusion

This study explored job satisfaction and career development among public and private sector employees in Bangladesh, aiming to identify differences between the two sectors and the key factors influencing employee perceptions. The findings indicate that, while overall job satisfaction levels are relatively similar, the drivers of satisfaction differ significantly. Public sector employees value job security, work-life balance, and stable career paths, whereas private sector employees are motivated by higher salaries, performance-based rewards, faster promotion, and professional growth opportunities.

Career development opportunities were found to be more structured but slower in the public sector, while private sector organizations provide faster and skill-focused career advancement. Factors such as salary, promotion opportunities, training, and work environment were confirmed as significant predictors of job satisfaction and professional growth, but the relative importance of these factors varies between sectors. These results support the study's hypotheses that sector type moderates the relationship between work-related factors and employee satisfaction.

Job satisfaction and career development are critical determinants of employee motivation and organizational performance, but the relative importance of these factors is sector-dependent. Public sector employees prioritize security and stability, whereas private sector employees focus on growth, advancement, and performance incentives. By understanding these differences, organizations can design targeted human resource strategies that enhance satisfaction, improve retention, and promote sustainable career development. Ultimately, fostering a work environment that aligns organizational goals with employee needs can significantly improve productivity, morale, and long-term organizational success in Bangladesh.

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குறள் கூறும் நிதி

முனைவர் பா. லயோலா சூலியட் மேரி,
இணைப் பேராசிரியர்,
பாத்திமா கல்லூரி,
தமிழ் உயராய்வு மையம், மதுரை.

முன்னுரை

ஆதிகாலத்தில் வாழ்ந்த மனிதன் இந்த உலகம், மண்ணாகவும் மலையாகவும் நீராகவும் நெருப்பாகவும் விண்ணாகவும் காடாகவும் நாடாகவும் இருந்த சூழலில் வாழ்ந்து வந்தான். அத்தகைய இயற்கைச் சூழலில் குடும்பத்தை அமைத்து அதை நிர்வகித்துப் பண்பாட்டைப் பேணிப் பாதுகாத்தான். தனிமனித நிலையிலும் சமூக அமைப்பிலும் வாழும்போது தனது தேவைகளை நிறைவேற்றல் அவனுக்கு அவசியமானதாக அமைந்தது. அதற்கு முழுமுதற்தேவையாக அமைந்தது பொருளே என்பதை உணர்ந்தான். பின்பு உணவு, உடை, உறையுள் என அவனது முதன்மையான தேவைகள் பெருகிய போது, தேவைகளை நிறைவேற்றிக்கொள்ள ஆக்கப்பூர்வமான பணிகளையும் பண்டங்களையும் ஆடைகளையும் படைத்தளித்த சூழலில் பொருளின் தேவையையும் உணரத் தொடங்கினான். எனவே இயற்றல், ஈட்டல், காத்தல், வகுத்தல் என்ற அடிப்படையில் பொருளின் சிறப்புகளை அறியத் தொடங்கினான். பொருளாதார வளம் பெற்றவர்கள் சமூகத்தில் மதிப்பும் மரியாதையும் பெற்றவர்களாகக் கருதப்பட்டனர். இந்நிலை இன்றளவும் தொடர்கிறது என்பதில் ஐயமில்லை. மனித வாழ்வில் பொருளின்

அவசியத்தையும், அதன் மேன்மை மற்றும் தன்மைகளையும் திருவள்ளுவர் தெளிவாக எடுத்துரைக்கிறார்.

பொருளின் மேன்மை

அன்பை அடிப்படையாகக் கொண்ட வாழ்வை நிலைநிறுத்துவதற்கு பொருள் முக்கியமான கருவியாக அமைகிறது. பொருள் இல்லாதவர்களுக்கு உலகியல் வாழ்க்கை சீராக அமையாது என்பதைத் திருவள்ளுவர் வலியுறுத்துகிறார். பொருள் இல்லார்க்கு இந்த உலக வாழ்வு இல்லை என்பதை அறத்துப்பாலில்,

“அருளிலார்க்கு அவ்வுலகம் இல்லை பொருளிலார்க்கு
இவ்வுலகம் இல்லாகி யாங்கு" (குறள். 247)

என்று நினைவூட்டுகிறார். பொருட்பாலில் ‘பொருள் செயல்வகை’ என்ற அதிகாரத்திலும் இதனை வலியுறுத்துகிறார். அறத்துப்பாலில் அருளை உயர்த்திக் கூறும் சூழலில், உவமையாகப் பொருளை முன்வைத்து அதன் சிறப்பை விளக்குகிறார். அருள் நிலைபெற்று வளர்வதற்குப் பொருள் துணையாக இருப்பதாக அவர் கருத்துரைக்கிறார். அன்பு பெற்ற அருள் என்னும் குழந்தையை, பொருள் செவிலித்தாயாக இருந்து வளர்த்தால் தான் வளரும் என்கிறார்.

“அருளென்னும் அன்பீன் குழவி பொருளென்னும்
செல்வச் செவிலியால் உண்டு." (குறள். 757)

இவ்வாறு கூறியபின் அறமும் இன்பமுமாகிய வாழ்க்கைப் பகுதிகளுக்குப் பொருள் கட்டாயம் வேண்டும் என்றும் தெரிவிக்கின்றார். பொருள் பெற்றவர்க்கே அற வாழ்க்கையும் எளிது, காதலாகிய இன்பவாழ்க்கையும் எளிது என்கிறார். இதனை,

”அறன்ஈனும் இன்பமும் ஈனும் திறன்அறிந்து
தீதின்றி வந்த பொருள்" (குறள். 754)

என்ற குறட்பாவிலும்,

"ஒண்பொருள் காழ்ப்ப இயற்றியார்க்கு எண்பொருள்

ஏனை இரண்டும் ஒருங்கு" (குறள். 760)

என்ற குறட்பாவிலும் விளக்குகிறார்.

திருவள்ளுவர் பொருட்பாலில் பொருள் செயல்வகை அதிகாரத்தில் நல்லநாட்டின் வாழ்க்கையை விரித்துரைக்கிறார். 'வினையே ஆடவர்க்கு உயிரே' (135) என்ற இலக்கிய வரியும் வினையும் அதன்வழி பெறப்படும் பொருளும், மதிப்பும் சங்ககாலம் தொட்டு சிறப்பிக்கப்படுகிறது என்பது ஏற்புடையதே.

"இல்லாரை எல்லாரும் எள்ளுவர் செல்வரை
எல்லாரும் செய்வர் சிறப்பு" (குறள். 752)

எனும் குறள்வழி, பொருள் இல்லாவிட்டால் இழிநிலைக்கு ஆளாக நேரிடும் என்கிறார். எனவே உழைத்துப் பொருள் தேட வேண்டும் என்றும் உழைத்து ஈட்டிய பொருளைக் கொண்டு செய்யும் ஈகையே ஒருவனுக்குச் சிறப்பினைத் தரும் என்றும் கூறுகிறார்.

"கல்லானேயானாலும் கைப்பொருள் ஒன்றுண்டாயின்
எல்லாரும் சென்றால் கெதிர் கொள்வர் - இல்லானை
இல்லாளும் வேண்டாள் மற்றீன்றெடுத்ததாய் வேண்டாள்
செல்லாதவன் வாயிற் சொல்" (நல்வழி 34)

என்ற நல்வழிப் பாடல் பொருள் இல்லாதவனைப் பெற்ற தாயும் மனைவியும் விரும்பார் என்று கூறுகிறது. மேலும் கல்வியறிவே இல்லாதவனாயிருந்தாலும் செல்வமுடையவனாயின் அவனை எதிர்சென்று எல்லோரும் சிறப்புச்செய்வர் என்றும் கூறுகிறது.

நாட்டின் பொருள்வளம்

ஒரு நாட்டின் மேன்மை அந்நாட்டின் பொருள் வளத்தை அடிப்படையாகக் கொண்டு அமைகிறது. அத்தகைய நாட்டில் அரசியலில் பொறுப்பேற்று ஆட்சி நடத்துவோர் அடிக்கடி நாடுவது பொருளைத்தான். மற்றவர்கள் உழவும் தொழிலும் செய்து நாடி நிற்பதுவும் பொருளைத்தான். அத்தகைய முக்கியத்துவம் வாய்ந்த பொருளாதாரத் துறையில் நாட்டை ஆளும் தலைவனுக்குச் சில கடமைகள் உண்டு. பொருள் வரும் வழிகளைப் பெருக்க வேண்டும்.

வந்த வருவாயைத் திரட்டிச் சேர்க்க வேண்டும். சேர்த்த பொருளை அழிவுபடாமல் காக்க வேண்டும். பிறகு அவற்றைச் செலவுக்கு உரிய துறைகளில் சரியாக வகுத்துச் செலவு செய்ய வேண்டும். இவ்வாறு வருவாய் பெருக்கும் துறையிலும் வரவுசெலவுத் திட்டத்திலும் வல்லவனாகத் திகழ்பவனே சிறந்த தலைவனாவான். அவனது அரசே சிறந்த அரசு என்பதை,

“இயற்றலும் ஈட்டலும் காத்தலும் காத்த
வகுத்தலும் வல்லதுஅரசு"(குறள். 385)

என்ற குறள் வழி எடுத்துக்காட்டுகிறார் வள்ளுவர். இதன்வழி பொருளைப் பெறுவதோடு அதனைப் பராமரித்துப் பெருக்க வேண்டியதும் அரசின் கடமை என்பது தெளிவாகிறது.

வாழ்வியல் கடமை

தலைவனின் பொருளாதாரக் கடமைகள் மற்றும் அதனுடன் தொடர்புடைய ஒழுக்கநெறிகளை விளக்கிய திருவள்ளுவர், தனிமனிதன் பிறர்நலன் கருதி உதவும் பண்பை வளர்த்துக்கொள்ள வேண்டியதன் தேவையையும் எடுத்துரைக்கிறார். ஒப்புரவறிதல் என்னும் அதிகாரத்தில், ‘இல்லென இரந்துவந்தார் யாவர்க்கும் வரையாது கொடுக்கும் ஆற்றல் இல்லையெனினும் தம்மளவிற்கும் தம் வருவாய் அளவிற்கும் ஏற்ப, தக்கார்க்குத் தக்கன அறிந்து கொடுத்தலே சிறப்பு’ என்கிறார். அதிலும் குறிப்பாக ‘ஒப்புரவு’ என்னும் அதிகாரத்தில்,

“தாளாற்றித் தந்தபொருளெல்லாந் தக்கார்க்கு
வேளாண்மைசெய்தற் பொருட்டு” (குறள் 212)

என்ற குறளில் ஒருவன் முயன்று ஈட்டிய பொருளெல்லாம் தகுதி உடையார்க்கு உபகரித்தற்காகவாம் என்று உரை விளக்கமளிக்கிறார் மணக்குடவர். இதனையே நாலடியார்,

”. . . . . .தெரியுங்கால்
செல்வம் உடையாரும் செல்வரேதற் சேர்ந்தார்
அல்லல் களைப எனின்" (நாலடி.,170)

என எடுத்தியம்புகிறது.

“ஊருணி நீர்நிறைந் தற்றே உலகவாம்
பேரறி வாளன் திரு" (குறள். 215)

உலக நலனைக் கருத்தில் கொண்டு செயல்படும் உயர்ந்த அறிவுடையவரின் செல்வம், ஊரார் அனைவரும் பயன்படுத்தும் நீர்நிறைந்த குளத்தைப் போன்றது என வள்ளுவர் குறிப்பிடுகிறார். இக்கருத்திற்கு விளக்கம் அளிக்கும் பரிமேலழகர், அத்தகைய செல்வம் தனிப்பட்ட நலனுக்காக மட்டுமன்றி சமூகத்தின் அனைத்துத் தரப்பினருக்கும் பயனளிப்பதாக அமைகிறது எனக் கூறுகிறார். இச்செய்தியினைக் கம்பராமாயணமும்,

“ஊருணி நிறையவும் உதவுமாடுயர்
பார்கெழு பழுமரம் பழுத்தற் றாகவும்" (கம்பராமா., 1480)

என்று எடுத்தியம்புகிறது.

‘ஒப்புரவு’ அதிகாரம் போலவே ‘ஈகை’ அதிகாரத்திலும் வறியவர்க்கு அளிக்கப்படும் பொருள் குறித்து வள்ளுவர் கூறுகிறார். ஈகையாவது, தரித்திரராய் வந்து ஏற்கிறவர்களுக்கு இல்லை என்று கூறாது தானம் கொடுக்கிறது என்கிறார் கவிராசர்.

“வறியார்க்கொன்று ஈவதே ஈகைமற் றெல்லாம்
குறியெதிர்ப்பை நீர துடைத்து." (குறள். 221)

இக்குறளுக்கு வறியார்க்குக் கொடுப்பதே கொடை மற்றதெல்லாம் வட்டிக்குக் கொடுப்பதை ஒக்கும் என்று உரை விளக்கமளிக்கிறார் பரிதியார்.

“ஏற்றகை மாற்றாமை என்னானும் தாம்வரையார்
ஆற்றாதார்க் கீவதாம் ஆண்கடன் - ஆற்றின்
மலிகடல் தண்சேர்ப்ப மாறீவார்க் கீதல்
பொலிகடன் என்னும் பெயர்ந்து" (நாலடி. 38)

என்று நாலடியாரும் விளக்கமளிக்கிறது.

வளமுடையவர்கள் வாய்ப்பற்றோருக்கு வழங்கல், பகுத்துண்ணல், இவ்வறப்பணியை வள்ளுவர் விருந்தோம்பல், ஈகை,

ஒப்புரவு, நன்றி, சுற்றந்தழால், வேளாண்மை எனப் பல பெயர் சூட்டிப் பாராட்டுகிறார். வள்ளுவரது குறளில் விருந்தோம்பல், ஒப்புரவறிதல், ஈகை இம்மூன்று அதிகாரங்களும் இல்வாழ்வார்க்கு உரியன என்பார் பரிமேலழகர். 'நன்றியில் செல்வம்' குடிமக்களுக்குரியது. இதிலும் வள்ளுவர் பொருள் வழங்கலையே வற்புறுத்துகிறார். இவ்வாறே இரவு (அதி. 106), இரவச்சம் (அதி. 107) என்னும் இரண்டதிகாரங்களும் ஈகையின் சிறப்பையே விளக்குகின்றன.

அரசியல் தொடர்பான கருத்துக்களில் சுற்றந்தழால் மற்றும் பகுத்துண்ணல் ஆகிய பண்புகளின் அவசியமும் வலியுறுத்தப்படுகிறது. இதனைத் தொடர்ந்து, விருந்தோம்பல், ஒப்புரவறிதல், ஈகை, சுற்றந்தழால், நன்றியில் செல்வம், இரவு, இரவச்சம் ஆகிய ஏழு அதிகாரங்களிலும் திருவள்ளுவர் அறப்பணியின் முக்கியத்துவத்தை விரிவாக எடுத்துரைக்கிறார். எனவே, பொருளாதார வாழ்வில் அறநெறிச் செயல்களுக்கு அவர் வழங்கும் உயர்ந்த இடம் இதன் மூலம் தெளிவாகப் புலப்படுகிறது.

சான்றோர் கண்ட ஒழுகலாறுகளில் தன்னிடம் உள்ளதைப் பகுத்துப் பிறரோடு உண்ணுதல் தான் தலையானது.

"பகுத்துண்டு பல்லுயிர் ஓம்புதல் நூலோர்
தொகுத்தவற்றுள் எல்லாம் தலை" (குறள். 322)

உழைப்பு மற்றும் வருவாய் ஈட்டுதல் என்பவை தனிமனிதனின் உணவு, உடை, இருப்பிடம் போன்ற அடிப்படைத் தேவைகளைப் பூர்த்தி செய்வதற்கான வழிமுறைகளாகவே இன்றைய பொருளாதாரக் கோட்பாடுகளும் சமூகப் பார்வைகளும் கருதுகின்றன. எனினும், திருவள்ளுவர் இக்கருத்திற்கு மாறுபட்ட பரிமாணத்தை வழங்குகிறார். அவர், தனிநல மையக் கண்ணோட்டத்திற்குப் பதிலாகப் பிறர்நலத்தை மையப்படுத்திய அணுகுமுறையை முன்வைத்து, பொருளின் பயன்பாடு சமூக நலனுடன் இணைந்திருக்க வேண்டும் என்பதை வலியுறுத்துகிறார்.

உழைப்பே உயர்வு

ஈகை மனிதனின் உயர்ந்த அறப்பண்புகளுள் முதன்மையானதாகக் கருதப்படுகிறது. அதேவேளையில், உழைப்பே மனித வாழ்விற்கு பெருமையையும் உயர்வையும் வழங்கும் அடிப்படைக் காரணியாக அமைகிறது. மேலும், வறுமையைப் போக்குவதற்கான வழி இரத்தல் அல்ல; உழைப்பின் மூலம் வாழ்க்கையை முன்னேற்றுவதே சிறந்த நெறி என்பதைத் திருவள்ளுவர் வலியுறுத்துகிறார்.

“இன்மை இடும்பை இரந்துதீர் வாம்என்னும்
வன்மையின் வன்பாட்டது இல்” (குறள். 1063)

இக்குறளின் மூலம், வறுமையை நீக்குவதற்கான வழிமுறையாக இரத்தலை ஏற்றுக்கொள்ளும் மனப்பான்மையைத் திருவள்ளுவர் கடுமையாக விமர்சிக்கிறார். வறுமையால் ஏற்படும் துன்பங்களை இரத்தல் மூலம் போக்கலாம் என்ற எண்ணமே மிகுந்த அறியாமையின் வெளிப்பாடாகும் என்பதை அவர் சுட்டிக்காட்டுகிறார். இதன்வழி, தன்னிறைவு, உழைப்பு மற்றும் முயற்சியின் அவசியத்தை வலியுறுத்தும் சமூகச் சிந்தனையைத் திருவள்ளுவர் முன்வைக்கிறார். வள்ளுவர், வறுமையை வெறுத்த காரணங்களாலேயே ‘இரவச்சம்’ என்ற அதிகாரத்தையும் இயற்றியுள்ளார். வறுமைக்கு உழைப்புதான் வழி என்கிறார். உழைத்து உண்பதை இனியது என்பதை,

“தெண்ணீர் அடுபுற்கை ஆயினும் தாள்தந்தது
உண்ணலின் ஊங்கினிய தில்.” (குறள். 1065)

உழைப்பின் பலனாகக் கிடைக்கும் உணவு சாதாரண கூழாக இருந்த போதிலும், அது இரத்தலால் பெறப்படும் செல்வத்தைவிட மேன்மையானது என்பதைத் திருவள்ளுவர் வலியுறுத்துகிறார். தகுதியுள்ளோரெல்லாம் உழைத்தல் வேண்டும். தகுதி இழந்தோரை ஈகையாளர் பகுத்துண்டு தாங்குவர். இதுவே வள்ளுவர் கண்ட

பொருள் வாழ்வின் அடித்தளம். ஈகைப் பண்பு அவசியம் என்றாலும் ‘உழைப்பே உயர்வு தரும்’ என்றும் சிறப்பிக்கிறார்.

பொருள் நிலையாமை

பொருள் விருப்பத்தை உள்ளத்தில் கொண்டிருந்தும், அன்பின் தோற்றத்துடன் வெளிப்படையாக நடந்துகொள்ளும் பொதுமகளிரின் தொடர்பு, கள்ளுண்ணுதல் மற்றும் சூதாட்டம் ஆகியவற்றுடன் இணைந்து பொருளாதாரச் சீர்கேட்டிற்கு வழிவகுக்கும் காரணிகளாகத் திருவள்ளுவரால் சுட்டிக்காட்டப்படுகின்றன. இதன் அடிப்படையில், இத்தகைய பழக்கவழக்கங்களில் ஈடுபடுபவர்கள் சமூகப் பொறுப்புணர்வும் ஒழுக்கநெறியும் கொண்ட பொதுவாழ்க்கைக்கு ஏற்றவர்களாக இருக்க முடியாது என்ற கருத்தை அவர் முன்வைக்கிறார்.

பொருள் மனித வாழ்வின் இன்றியமையாத தேவையாகும் என்பதைத் திருவள்ளுவர் பல்வேறு இடங்களில் எடுத்துரைத்தாலும், செல்வமே வாழ்க்கையின் இறுதி இலக்கு அல்லது முழுமையான நிறைவு என அவர் கருதவில்லை. அதற்கு மாறாக, செல்வத்தின் நிலையாமையைச் சுட்டிக்காட்டி அதன் மீதான பற்றினைக் குறைக்க வேண்டியதன் அவசியத்தை வலியுறுத்துகிறார். நிலையாமை மற்றும் அவாஅறுத்தல் அதிகாரங்களின் வழி, உலகியல் செல்வங்கள் அழியக்கூடியவை என்பதையும், அவற்றின் மீது ஆசையற்ற மனநிலையே உயர்ந்த செல்வமாகும் என்பதையும் அவர் விளக்குகிறார்.

“அற்கா இயல்பிற்றுச் செல்வம் அதுபெற்றால்
அற்குப ஆங்கே செயல்" (குறள். 333)

இக்குறளில் செல்வநிலையாமை மையக் கருத்தாக அமைகிறது. செல்வம் நிலைத்திராத இயல்புடையதாதலால், அது கைவசம் உள்ளபோதே அழியாத பயனைத் தரும் அறச்செயல்களில் ஈடுபட வேண்டும் என அறிவுறுத்துகிறார். இதன் வழி, பொருளின் நிலையற்ற தன்மையையும் அறத்தின் நிலைத்த தன்மையையும்

ஒப்புநோக்கி, அறச்செயல்களின் முக்கியத்துவத்தை அவர் வலியுறுத்துகிறார்.

“துகடீர் பெருஞ்செல்வந் தோன்றியக்கால் தொட்டுப்
பகடு நடந்த கூழ் பல்லாரோடுண்க
அகடுற யார்மாட்டும் நில்லாதுசெல்வம்
சகடக்கால் போல வரும்” (நாலடி. 2)

என்று நாலடியாரும் பொருள் நிலையில்லாதது என்பதை விளக்குகிறது.

“வேண்டாமை அன்ன விழுச்செல்வம் ஈண்டில்லை
ஆண்டும் அஃதொப்பது இல்." (குறள். 363)

என்று அவாவின்மை போல மிக்கசெல்வம் இல்லை. அதனையொப்பது பிறிதில்லை என்று வள்ளுவர் கூறுகிறார். யாக்கையைப் போலச் செல்வமும் நிலையில்லாதது என்பதை, “செல்வமானது நிலைத்து நிற்காத இயல்பினை உடையது. அத்தகைய செல்வத்தைப் பெற்ற ஒருவன் செய்யக்கூடிய நிலையான அறச்செயல்களை அப்போதே செய்ய வேண்டும்” என்று திருவள்ளுவர் கருத்தை விளக்குகிறார் இரா. வரலட்சுமி.

“கூத்தாட்டு அவைக்குழாத்து அற்றே பெருஞ்செல்வம்
போக்கும் அதுவிளிந் தற்று" (குறள். 332)

எனும் குறளின் வழி, “நாடகத்திற்கு வரும்போது தனித்தனியாக வந்த மக்கள் நாடகம் முடிந்த பிறகு ஒன்று சேர்ந்து ஒரேயடியாய் போய்விடுவது போல வருங்காலத்தில் கொஞ்சம் கொஞ்சமாய் வந்த செல்வம் போகும் காலத்திலும் ஒரேயடியாய் போய்விடும் அத்தகைய செல்வம் நிலையானது என்று மயங்காதே. அப்புல்லறிவால் துன்பத்தை ஏற்காதே" என்று அறிவுறுத்துகிறார் திருவள்ளுவர். இக்கருத்தை வலியுறுத்தும் விதமாக,

“சலத்தால் பொருள் செய்துஏமாத்தல் பசுமண்
கலத்துள்நீர் பெய்து இரீஇ யற்று” (குறள். 660)

என்கிறார் திருவள்ளுவர். இக்குறள், “பாவச் செயல் புரிந்து சம்பாதித்த செல்வத்தையும் பிறரைத் துன்புறுத்திப் பறித்த பணத்தையும் சேர்த்து பூட்டிவைத்தால் என்ன ஆகும்? (அழிந்து போகும்) பச்சை மண்குடத்தில் நீர் நிரப்பி வைத்தது போன்றதாகும் என்று விளக்குகிறது. தொட்டாரைத் தொட்டுக் கொண்டேயிருப்பின் பற்றலாகாது. பற்றகலாகவே வினை குவியும். வினை குவியவே பிறப்பும் இறப்பும் சகடக்கால் போல் மாறிமாறி விளையும். அதற்காகவே மெய்ந்நூல்கள் நிலையாமையை உணர்த்துகின்றன என்கிறார் தண்டபாணிதேசிகர்.

திருவள்ளுவர் பொருளின் அவசியத்தையும் அதன் பயனையும் ஏற்றுக்கொண்ட போதிலும், அதனை மனித வாழ்வின் உயர்ந்த மதிப்பாகக் கருதவில்லை. அன்பு, செய்ந்நன்றி, அடக்கம், ஒழுக்கம், ஒப்புரவு, ஈகை, புகழ், வாய்மை, கல்வி, கேள்வி, அறிவு, கண்ணோட்டம், நட்பு, குடிமை, மானம், சான்றாண்மை போன்ற அதிகாரங்களின் வழி, பொருளைவிட மனிதனின் நற்பண்புகளுக்கே அவர் அதிக முக்கியத்துவம் அளிக்கிறார். இப்பண்புகளே உண்மையான உடைமைகள் எனக் கருதும் திருவள்ளுவர், பொருட்செல்வத்தை நிலையான உடைமையாக ஏற்கவில்லை. அறத்தை அடிப்படையாகக் கொண்ட அவரது சிந்தனையில், மனிதப் பண்புகளே வாழ்வின் உயர்ந்த செல்வங்களாக விளங்குகின்றன. மேலும், வெற்றிபெறும் படையைக் கொண்ட அரசருக்குச் செல்வம் இன்றியமையாததாகக் கருதப்பட்டாலும், அதைவிட உயர்ந்தது அறநெறியும் பண்புடைமையும் என்பதே திருவள்ளுவரின் நிலைப்பாடாக அமைகிறது.

“கேடுஇல் விழுச்செல்வம் கல்வி” (குறள். 400)

“செல்வத்துட் செல்வம் செவிச்செல்வம் அச்செல்வம்
செல்வத்துள் எல்லாம் தலை” (குறள். 411)

“தம்பொருள் என்பதம் மக்கள்” (குறள். 63)

“வேண்டாமை அன்ன விழுச்செல்வம்” (குறள். 363)

“திறன் அறிந்துசொல்லுகசொல்லை அறனும்
பொருளும் அதனினூஉங்கு இல்” (குறள். 644)

“அருட்செல்வம் செல்வத்துட் செல்வம்” (குறள். 241)

“அறிவுடையார் எல்லாம் உடையார்” (குறள். 430)

“உள்ளம் உடைமை உடைமை” (குறள். 592)

“அறத்தினூஉங்கு ஆக்கமும் இல்லை” (குறள். 32)

“காக்க பொருளாஅடக்கத்தை ஆக்கம்
அதனினூஉங்கு இல்லை உயிர்க்கு” (குறள். 122)

“மனநலம் மன்னுயிர்க்குஆக்கம்” (குறள் 457)

“உறுப்பு அமைந்து ஊறுஅஞ்சா வெல்படைவேந்தன்
வெறுக்கையுள் எல்லாம் தலை” (குறள். 761)

உடைமை, செல்வம், ஆக்கம், வெறுக்கை, திரு, பொருள் - இவை எல்லாம் குறளில் ஒரு பொருளுடைய சொற்கள். இப்பண்புச் செல்வங்கள் எல்லாம் அழியா நிலைபேறுடையவை. பொருட்செல்வம் நிலைபேறு இல்லாதது.

“உள்ளம் உடைமை உடைமை பொருளுடைமை
நில்லாது நீங்கி விடும்.(குறள். 592)

செல்வம் சென்று விட்டால் தேடிக்கொள்ளலாம். ஆனால் அருள் முதலான செல்வங்கள் அழியுமானால் ஆக்கிக் கொள்ளுதல் அரிது; அரிதினும் அரிது. ஆகவே இவையெல்லாம் அரும்பொருள்கள். பொருட்செல்வம் வெறும் பொருள் என்கிறார்.

“பொருள் அற்றார் பூப்பர் ஒருகால் அருள்அற்றார்
அற்றார் மற்றுஆதல் அரிது. (குறள். 248)

அருள் முதலிய செல்வங்களை ஆன்றோரிடத்து மட்டுமே காணமுடியும். ஆனால் பொருட்செல்வம் தக்கார், தகவிலர் எனப் பாராது எல்லாரிடமும் குடிகொள்ளுகிறது. இது பொருட்செல்வத்துக்கு உரிய ஒருகுறை.

“அருட்செல்வம் செல்வத்துள் செல்வம் பொருட்செல்வம்
பூரியார் கண்ணும் உள.” (குறள். 241)

இன்றைய உலகின் பொருள் வாழ்வில் நல்லோர் கைப்பட்ட செல்வம் நன்மை நல்கும். தீயோர் கைப்பட்ட செல்வம் தீமையே தரும். பொருள் இல்லார்க்கு இவ்வுலகம் இல்லை; ஆதலால் எல்லோரும் பொருளீட்டுகின்றனர். உலகின் இயல்போ, "கேடும் பெருக்கமும் இல்லல்ல" என இருக்கின்றது. மக்கள் முயற்சியும் ஒருசீராக இருப்பதில்லை; செல்வம் சேர்தலும் ஒருசீராக இல்லை.

பொருளீட்டலுக்குத் தனிமனித முயற்சி மட்டும் போதுமானதன்று; அதனுடன் பொருத்தமான வாய்ப்புகளும் அவசியமாகின்றன. வாய்ப்புகளை உருவாக்கிக் கொள்ள இயன்றாலும், அவை அமையத் தேவையான தொடக்க முதலீடும் ஆதார வளங்களும் இன்றியமையாதவையாகும். "முதலில்லார்க்கு ஊதியம் இல்லை" என்ற கருத்து இதனை வலியுறுத்துகிறது. இத்தகைய காரணங்களால் மக்களின் பொருளாதார வாழ்வில் ஏற்றத்தாழ்வுகள் உருவாகின்றன. அதன் விளைவாக மனக்கசப்பு, பொறாமை, போட்டி மனப்பான்மை மற்றும் சமூக முரண்பாடுகள் தோன்றும் சூழல் ஏற்படுகிறது.

தொகுப்புரை

உலக வாழ்க்கைக்குப் பொருள் அவசியமானது. அத்தகைய சிறப்புடைய பொருளை முறையாக ஈட்டி அதனைக் காத்துத் தானதருமங்கள் செய்து அதன்மீது மட்டும் முழு ஈடுபாடு இல்லாமல் வாழ்வதே சிறப்புக்குரிய வாழ்வாகும். தனிமனிதன் மட்டுமின்றி சமுதாயமும் இளமை நிலையாமை, செல்வ நிலையாமை, யாக்கை நிலையாமை எனும் மூன்று நிலைகளை உள்ளடக்கியது. ஆகவே ஆசையை நீக்கி வாழும்போதே அறத்தொடு வாழ்ந்து பிறர்க்கு உதவி வாழ்தல் சிறந்தது என்பது தெளிவாகிறது.

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Social Media as a Challenge and Opportunity for EFL Reading Development: Perspectives from Karakalpakstan, Uzbekistan

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Abstract

This paper examines social media as both a challenge and an opportunity for EFL reading development among students in Karakalpakstan, Uzbekistan. In the digital age, platforms such as Instagram, YouTube, Telegram, TikTok, and Facebook have become part of students' daily learning and communication practices. While these platforms provide access to English content, articles, blogs, educational videos, and online discussions, they may also reduce students' motivation to engage with long-form reading. The study employed a mixed-method approach using a structured questionnaire and open-ended questions to explore 120 students' perceptions of social media and its influence on reading interest, motivation, attention, and reading habits. The findings indicate that social media can distract students from reading, encourage preference for short texts, and weaken concentration during academic reading tasks. However, the findings also show that social media can support EFL reading development when it is used purposefully through teacher-curated materials, digital reading tasks, peer discussion, and guided reading strategies. The paper concludes that social media should not be viewed only as a negative influence, but as a digital tool that can be transformed into a meaningful resource for EFL reading development. The study recommends that EFL teachers guide students to balance social media use with regular reading practice and integrate digital platforms into reading instruction in a structured and purposeful way.

Keywords: Digital Reading, EFL Students, Karakalpakstan, Reading Development, Reading Motivation, Social Media, Uzbekistan

Introduction

Sustainable In the contemporary digital age, social media has become an inseparable part of students' academic, social, and personal lives. Platforms such as Instagram, YouTube, Telegram, and TikTok provide learners with quick access to information, entertainment, communication, and educational content. For English as Foreign Language (EFL) students, social media can create opportunities for exposure to English vocabulary, authentic texts, online discussions, videos, articles, and other forms of language input (Jalgasbaevna & Panicker, 2025). In this sense, social media may function as a supportive digital environment for language learning and reading development. Recent studies have shown that social media can support EFL learners' motivation, interaction, and access to language-learning resources when it is used purposefully in educational contexts (Win et al., 2025).

Challenges of Social Media for Reading Habits

However, social media also presents significant challenges for students' reading habits and reading development. The frequent use of short videos, captions, comments, posts, and instant messages may encourage students to prefer short and easily accessible content rather than longer academic texts. As a result, students may experience reduced patience, weaker concentration, and lower motivation to engage with extended reading materials. Research on students' reading habits has reported that social media can create distraction during study time, even when it may also have positive effects on access to reading materials.

Reading remains one of the most important skills in EFL learning because it supports vocabulary development, grammar awareness, comprehension, academic achievement, and independent learning. For EFL students, regular reading is especially important because English is not commonly used as a daily communication language outside the classroom. Therefore, students need continuous exposure to English texts in order to improve their language proficiency. Online reading practices can contribute positively to reading comprehension when learners engage with digital texts meaningfully and consistently.

Context and Purpose of the Study

In the context of Karakalpakstan, Uzbekistan, the influence of social media on EFL students' reading development deserves particular attention. Many students use multiple languages in their daily lives, including Karakalpak, Uzbek, Russian, and English. This multilingual environment may shape how students' access, interpret, and engage with English reading materials. At the same time, the increasing popularity of social media among young learners may affect their willingness to read longer English texts, especially academic articles, books, and study-related materials (Nargiza & Panicker, 2025). Therefore, it is important to examine both the negative and positive roles of social media in EFL reading development. This paper explores social media as both a challenge and an opportunity for EFL reading development among students in Karakalpakstan, Uzbekistan. It focuses on how social media may distract students from long-form reading while also providing new possibilities for discovering English content, improving language exposure, and encouraging digital reading practices. By examining students' perspectives, the paper aims to contribute to a better understanding of how EFL teachers can reduce the negative effects of social media and use digital platforms more effectively to support students' reading engagement.

Thus, the study is guided by the following objectives: to examine how social media influences EFL students' reading interest, to identify the challenges social media creates for reading engagement, and to explore how social media can be used as an opportunity to support EFL reading development in the digital age.

Review of Related Literature

Social Media in Contemporary EFL Learning

Social media has become an important part of contemporary EFL learning because it provides learners with continuous access to English content, communication, and digital resources. Platforms such as YouTube, Instagram, Telegram, TikTok, and Facebook expose learners to vocabulary, pronunciation, authentic language use, captions, comments, articles, videos, and peer interaction. Recent literature suggests that social

media can support EFL learners' language development when it is used purposefully and under teacher guidance. (N & U, 2025) explains that social media can contribute to vocabulary acquisition, grammar development, comprehension, and overall English proficiency, while also noting that it may create disadvantages when it is not used appropriately. Similarly, (Dadakhonov, 2024) reports that social media can create opportunities for online learning resources and academic interaction, but it may also become a source of distraction when students overuse it. Therefore, social media should not be viewed only as a negative influence; rather, its educational value depends on how students and teachers use it in the learning process.

Reading Motivation and Digital Reading in EFL Contexts

Reading is a central skill in EFL development because it supports vocabulary growth, comprehension, academic achievement, and independent language learning. For EFL students, reading motivation is particularly important because English is often not used as the main language of everyday communication. (Akobirov, Feruz Rahmatjonovich, 2017) found a significant positive relationship between reading motivation and reading comprehension achievement among English-major students, indicating that motivated learners tend to perform better in reading comprehension. This suggests that if social media reduces students' motivation to read long English texts, it may indirectly affect their reading development and academic progress. At the same time, if social media is used to introduce interesting English materials, articles, e-books, or educational content, it may increase learners' motivation to read.

Recent studies on digital reading show that students increasingly engage with texts through screens, online platforms, and multimodal materials. (Kdirbaeva & Usenova, 2021) found that university students use digital reading strategies such as goal setting, skimming, and avoiding unnecessary links or advertisements while reading online materials. However, the same study also showed that only half of the students who read from screens demonstrated full comprehension, suggesting that digital reading may create cognitive challenges if learners do not use effective reading strategies. This finding is important for EFL reading development because social media reading often includes hyperlinks, images, videos, comments, and notifications, all of which may increase cognitive load and reduce deep comprehension.

Challenges of Short-Form Content and Habitual Scrolling

One major challenge of social media for EFL reading development is the popularity of short-form content. Short videos, reels, captions, and brief posts encourage fast consumption of information and may influence students' patience with longer academic texts. (Polatovna & Uli, 2020) found that frequent exposure to short reels on platforms such as TikTok, Instagram, and YouTube might reduce undergraduate students' attention span and impair academic performance. Their study also suggests that teaching strategies can help reduce the cognitive overload caused by short media consumption. This supports the argument that social media may weaken students' ability to concentrate on extended reading tasks, especially when they become accustomed to quick and entertaining content.

In addition to short-form video exposure, habitual scrolling may also affect students' attention and reading engagement. (Jaakkola, 2025) found that short-form video use and scroll immersion were associated with attention difficulty, working memory disruption, and cognitive fatigue among social media users. This is relevant to EFL reading because

successful reading requires sustained attention, memory, and active comprehension. When students frequently move from one short item to another, they may find it more difficult to remain focused on long English texts, academic articles, or book chapters. As a result, social media can become a challenge for developing stable reading habits and deep reading skills.

Social Media as an Opportunity for EFL Reading Development

Despite these challenges, social media can also serve as an opportunity for EFL reading development. (Mirqodirova, 2025) found that social media applications can support second language learning, especially listening, speaking, and reading skills, although they emphasise that such use should be guided and supervised by professional teachers. This means that teachers can transform social media from a distraction into a learning tool by selecting suitable English reading materials, sharing reliable links, connecting social media posts to full articles, and encouraging students to discuss what they read. In this way, social media can become a bridge between students' digital habits and meaningful EFL reading practice.

The literature also highlights the importance of teacher mediation in the digital age. Since students already spend considerable time on social media, teachers can use this familiarity to encourage reading rather than completely reject digital platforms. For example, teachers may begin with a short post, video, or news headline and then guide students to read a full article, story, or academic text on the same topic. Reading logs, digital annotation, peer discussion, teacher-curated links, and classroom rules for phone use may also help students manage distraction and develop stronger reading routines. This is consistent with recent research suggesting that the educational impact of social media depends on moderation, purpose, and instructional design rather than frequency of use alone.

In the context of Karakalpakstan, Uzbekistan, this issue is especially important because EFL students often study English within a multilingual environment where Karakalpak, Uzbek, Russian, and English may all be used in different domains. Social media may expose students to English content beyond the classroom, but it may also increase reliance on short, mixed-language, or entertainment-based content. Therefore, the present paper views social media as both a challenge and an opportunity for EFL reading development. It may distract students from long-form reading and reduce attention, but it may also provide access to authentic English materials, increase motivation, and support digital reading when used with appropriate pedagogical guidance.

Objectives

This article are to examine how social media influences EFL students' reading interest and engagement in Karakalpakstan, Uzbekistan. It seeks to identify challenges posed by platforms such as Instagram, YouTube, Telegram, and TikTok, particularly the tendency to prefer short, easily accessible content to extended academic texts. The study aims to analyse the effects of distraction and reduced concentration during study time, while also recognizing the importance of continuous exposure to English texts for vocabulary, grammar, and comprehension development. Another objective is to explore opportunities offered by social media, including authentic language input, online discussions, and digital reading practices that can support language proficiency.

The research further intends to investigate students' perspectives on how social media can both hinder and enhance reading development. It aims to assess the role of multilingual environments in shaping students' engagement with English texts and to evaluate strategies that teachers can adopt to minimize negative impacts while leveraging digital platforms effectively. Ultimately, the study seeks to contribute to EFL pedagogy by providing insights into how educators can balance the challenges and opportunities of social media, encourage meaningful reading practices, and foster sustained motivation for long-form English reading in the digital age.

Methodology

This study employed a mixed-method research design to examine social media as both a challenge and an opportunity for EFL reading development among students in Karakalpakstan, Uzbekistan. This approach was appropriate because it enabled the study to collect measurable data through questionnaire responses and deeper insights through open-ended answers.

The participants of the study were 120 EFL students from Karakalpakstan, Uzbekistan. They were selected because they study English as a foreign language in a multilingual context where Karakalpak, Uzbek, Russian, and English are commonly used. The participants represented different demographic backgrounds in terms of age, gender, language use, digital device access, internet access, preferred social media platforms, daily social media use, daily reading time, and preferred reading format. A structured questionnaire was used as the main research instrument. It consisted of five sections: demographic profile, social media's influence on reading interest, pedagogical strategies to reduce the negative effects of social media, pedagogical strategies to foster reading habits in the digital age, and open-ended questions. The closed-ended items were measured using a five-point Likert scale ranging from 1 = Strongly Disagree to 5 = Strongly Agree.

Analysis

The quantitative data were analysed using descriptive statistics, including frequency, percentage, mean, and standard deviation. These procedures helped identify general patterns in students' perceptions of social media and EFL reading development. The qualitative responses from the open-ended questions were analysed thematically to identify key issues such as distraction, reduced motivation, preference for short texts, discovery of English materials, and teacher-guided reading support. Ethical considerations were observed throughout the study. Participants were informed about the purpose of the research, participation was voluntary, and all responses were treated confidentially and used only for academic purposes.

The indication is that social media has a dual influence on EFL students' reading development in Karakalpakstan, Uzbekistan. It functions both as a challenge and as an opportunity, depending on the purpose of use, the amount of time spent on social media, and the level of teacher guidance provided. The responses suggest that social media is not simply a negative digital distraction; rather, it is a complex learning environment that can either weaken or support students' reading engagement. When students use social media mainly for entertainment, scrolling, short videos, and instant communication, it may reduce their interest in long-form reading. However, when social media is used purposefully for accessing English materials, following educational content, and engaging with teacher-curated resources, it can support EFL reading development.

Overall, this methodology provided a balanced understanding of how social media can both hinder and support EFL students' reading development in the digital age.

Findings and Discussion

One of the major findings is that social media may reduce students' interest and motivation to read longer English texts. Many students are frequently exposed to short texts, captions, comments, reels, and videos, which may encourage them to prefer quick and easily understandable content. This preference can make academic reading appear more difficult, time-consuming, and less attractive. In an EFL context, reading already requires additional cognitive effort because students need to understand vocabulary, sentence structure, grammar, and meaning at the same time. Therefore, when students become accustomed to short-form content, they may find it harder to remain patient and focused while reading longer English texts. This suggests that social media may gradually reshape students' reading behaviour by encouraging surface-level reading rather than deep and sustained engagement with texts.

The findings also show that social media affects students' attention and reading discipline. Notifications, messages, continuous scrolling, and algorithm-based content can interrupt students during reading tasks and reduce their ability to concentrate. As a result, students may postpone planned reading, read for a shorter period, or choose social media over reading during their free time. This is significant because successful EFL reading depends not only on language knowledge but also on sustained attention and reading stamina. If students frequently shift their attention between reading and social media, their comprehension and engagement with English texts may be weakened. Therefore, the findings suggest that social media distraction is not only a matter of time management but also a challenge related to attention control and self-regulated learning.

At the same time, the findings reveal that social media can also create opportunities for EFL reading development. Students may encounter English posts, articles, blogs, news, e-books, educational videos, and discussion threads through social media platforms. These materials can increase students' exposure to English outside the classroom and introduce them to topics that match their personal interests. In this way, social media can act as a gateway to reading, especially when students are encouraged to move from short online content to longer and more meaningful texts. For example, a short post, video, or headline can be used as an entry point for reading a full article, story, or academic text. This indicates that the educational value of social media depends on how it is used and whether students are guided to engage with content critically and purposefully.

The findings further highlight the important role of teachers in managing the influence of social media on reading development. Teacher guidance is essential in helping students balance digital media use with regular reading practice. Classroom rules limiting phone use, reading goals, reading logs, quizzes, annotation, summaries, and peer discussions can help students stay focused and accountable during reading tasks. Teacher-curated links and digital reading activities can also guide students from short social media content to extended English reading materials. These strategies show that teachers should not only restrict social media use but also teach students how to use digital platforms responsibly for learning.

Overall, the findings suggest that social media can either weaken or support EFL students' reading development depending on the way it is integrated into students' learning practices. It becomes harmful when students use it mainly for passive entertainment, short-form content, and continuous scrolling. However, it becomes useful when teachers integrate it into reading instruction in a structured and purposeful way. In the context of Karakalpakstan, Uzbekistan, where students learn English in a multilingual environment, social media can provide valuable exposure to English beyond the classroom. Therefore, EFL teachers should help students develop digital reading awareness, manage distractions, and use social media as a bridge toward stronger reading habits and deeper engagement with English texts.

Conclusion

This paper examined social media as both a challenge and an opportunity for EFL reading development among students in Karakalpakstan, Uzbekistan. The discussion showed that social media can negatively affect students' reading habits by reducing their interest in long-form reading, distracting them during study time, and encouraging a preference for short and easily accessible content. These challenges may weaken students' motivation, concentration, and engagement with academic English texts. At the same time, social media can also support EFL reading development when it is used purposefully. It provides students with access to English posts, articles, blogs, news, e-books, educational videos, and other digital materials. Therefore, social media should not be viewed only as a harmful influence, but as a tool that can create meaningful reading opportunities if guided properly.

The paper highlights the important role of teachers in helping students manage social media use and develop stronger reading habits. Strategies such as classroom phone rules, reading goals, reading logs, annotation, summaries, peer discussions, teacher-curated links, and digital reading tasks can help reduce distraction and encourage students to engage with longer English texts.

Overall, social media has a dual role in EFL reading development. It may become a barrier when students use it mainly for entertainment and continuous scrolling, but it may become a valuable learning resource when integrated into reading instruction in a structured and purposeful way. Therefore, EFL teachers in Karakalpakstan should guide students to use social media critically, balance digital media use with regular reading practice, and transform online platforms into supportive spaces for English reading development.

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Lithological-Stratigraphic, Paleo Geographic, and Geochemical Conditions of Formation and Petroleum Potential of the Lower Jurassic Petroleum Complex of the North Ustyurt Depression

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Abstract

This article presents the history and results of studies on the sedimentation conditions and structural features of Lower Jurassic deposits; the targeted study of whose productivity is being conducted in the Ustyurt region. Currently, gas saturation in Lower Jurassic deposits has been proven in the central part of the region, within the Kuanysh-Koskala and Berdakh swells, the Sudochye trough, and the Shakhpakhta step, where gas condensate reservoirs are confined to a depth interval of 3100...5200 m (Yuldasheva, 2019). It has been established that the greatest range of gas saturation in Lower Jurassic deposits is confined to the rift zone in the central part of the Ustyurt region, identified by geophysical data and partially confirmed by deep drilling results in the areas of the Berdakh swell and Sudochye trough. Within the Kuanysh-Koskala swell, due to the structural features of the Lower Jurassic deposits, no more than four productive horizons have been identified. However, the possibility of their increase in the subsided parts cannot be excluded. Based on analysis of geological-geophysical materials, areas are identified that are forecasted as prospective sites characterized by increased thicknesses of sediments, presence of reservoirs and seals, enrichment in dispersed organic matter, where deep drilling results have identified a Lower Jurassic potentially productive complex (Yuldasheva, 2024). To effectively conduct exploration work, this direction has been substantiated with the aim of obtaining reserve increments of gas, condensate, and possibly oil. Unlike other oil and gas-bearing regions of Uzbekistan, where development of new directions is associated with depletion of the main productive horizons, the Ustyurt region is characterized by poor geological-geophysical investigation. Work on the Lower Jurassic direction does not preclude continuation of work on the search for hydrocarbon deposits in the regionally productive Upper-Middle Jurassic deposits, including territories poorly studied and unstudied by geological-geophysical methods.

Keywords: Condensate, Gas, Lower Jurassic, Mudstone, Petroleum Complex, Sandstone

Introduction

Lower Jurassic deposits constitute one of the petroleum complexes with which high prospects for replenishing the hydrocarbon resource base of the Republic of Uzbekistan are associated (Yuldasheva, 2024). This direction has particularly gained momentum in its northwestern part - the Ustyurt petroleum region, where in recent years targeted research has been conducted to determine petroleum potential, resulting in high-rate

flows of gas and condensate from terrigenous reservoirs of Lower Jurassic age. Further development of exploration for new hydrocarbon deposits of various phase compositions is justified by the presence within it of all features of a petroleum system (reservoirs, seals, gas-generating deposits). The history of their study began in the middle of the last century, when terrigenous deposits were penetrated, whose age was determined as Lower Jurassic; the lithological-stratigraphic and reservoir properties of rocks were studied, and commercial flows of gas and condensate were obtained at the Kuanysh, Akchala, and Eastern Barsakelmes fields (Abdullaev et al., 2019)

Alimov, 2006, Yuldasheva, 2019, 2024). During subsequent appraisal, only non-commercial flows of gas, condensate, and oil were obtained. As a result, a conclusion was made that by the end of the Cretaceous, the gas source rocks contained in the formation had realized their productivity potential, and the hydrocarbons contained in them were of remigration character (Abetov et al., 2000]. However, the peculiarities of the geological structure of the Lower Jurassic terrigenous sequence depending on the history of geological development and sedimentation conditions were not taken into account, and there are territories where Lower Jurassic sediments have their own generation potential. The next conclusion concerned the lenticular structural character of the Lower Jurassic sequence and low prospects for discovering accumulations on the Kuanysh-Koskala swell (Rybalchenko et al., 2011). It should be noted that within this tectonic element, Lower Jurassic deposits have a very consistent character, in which sandy horizons are confidently traced throughout the territory and whose productivity has been confirmed at the Beskala, Saikhun, and Kushkair prospects based on the results of renewed exploration work. One of the reasons for the low prospectivity of the Kulbai trough was the presence of dense rocks of Permian-Triassic age underlying the Jurassic section (Krylov et al., 2015). However, on the Kuanysh-Koskala swell, under similar conditions of interaction between Jurassic and Permian-Triassic deposits, flows of gas and condensate were obtained from Lower Jurassic deposits at the Eastern Barsakelmes, Kuanysh fields, etc.

Thus, it can be stated that the level of investigation of Lower Jurassic deposits in the Ustyurt region is quite low and the petroleum prospects were ambiguous. At the current stage of their appraisal, it has been established that the structure of Lower Jurassic deposits depends on their confinement to various tectonic elements, which affects the generation, migration, and accumulation of hydrocarbon fluids, the presence and number of productive horizons, etc. (Yuldasheva, 2024).

Review of the Related Literature

Research on the petroleum potential of Uzbekistan, particularly the Ustyurt region, has evolved through decades of stratigraphic, lithological, and geochemical investigations. Foundational works such as Abdullaev et al. (2019) provide a comprehensive overview of the country's oil and gas fields, establishing the regional context for exploration. Early studies by Davlyatov and Pak (1987) highlighted the significance of rift structures in the Turan Plate, while Abetov and Labutina (2000) emphasized lithological-stratigraphic and facies-paleogeographic criteria for Jurassic deposits in Southwest Priaralye.

Subsequent research shifted toward detailed stratigraphic and sediment logical analyses. Alimov (2006) and Boykobilov et al. (2008) examined Jurassic sedimentation patterns in Ustyurt, contributing to the understanding of depositional environments. Gafarov and Gulev (2010) introduced new perspectives on petroleum prospects in Eastern Ustyurt,

while Krylov et al. (2015) applied play analysis to guide exploration strategies. Lyugay et al. (2010) further integrated lithological-facies analysis with petroleum potential assessments in Southern Priaralye.

Recent studies have increasingly focused on geochemical and reservoir characteristics. Mukhutdinov et al. (2019) assessed petroleum prospects of Lower Jurassic deposits using geological-geochemical data, complemented by Rybalchenko and Zabolotnaya (2011) who analysed reservoir properties of Jurassic sand-clay formations. Yuldasheva (2019, 2022, and 2024) contributed significantly to understanding the structural and productive horizons of Lower Jurassic sediments in the North Ustyurt Basin, marking a progression toward more refined exploration models.

Collectively, these works demonstrate a trajectory from broad regional assessments to specialized stratigraphic, geochemical, and reservoir-focused studies. This literature underscores the evolving methodologies and growing sophistication in evaluating the petroleum potential of Uzbekistan's Jurassic deposits, particularly within the Ustyurt Basin.

Objectives

The primary objective of current research on the Lower Jurassic deposits of the Ustyurt petroleum region is to reassess their hydrocarbon potential in light of recent discoveries and renewed exploration efforts. While earlier studies concluded that these deposits had exhausted their productivity potential by the end of the Cretaceous and hydrocarbons were largely of remigration character (Abetov et al., 2000), new findings suggest that certain tectonic elements still retain active generation capacity. Thus, the aim is to clarify the geological structure, sedimentation conditions, and reservoir properties that influence hydrocarbon generation, migration, and accumulation.

A second objective is to evaluate the variability of petroleum prospects across different tectonic elements such as the Kuanysh-Koskala swell, Kulbai trough, and Eastern Barsakelmes field. This involves determining the consistency of sandy horizons, identifying productive reservoirs, and understanding the role of Permian-Triassic basement rocks in shaping petroleum potential. By integrating lithological-stratigraphic, geochemical, and tectonic analyses, researchers seek to establish a more reliable model of petroleum system functioning in the region.

Ultimately, the overarching goal is to reduce ambiguity in the appraisal of Lower Jurassic deposits and to provide a scientifically grounded basis for further exploration strategies. This includes identifying productive horizons, assessing phase compositions of hydrocarbons, and ensuring that the Ustyurt Basin continues to contribute significantly to the hydrocarbon resource base of Uzbekistan.

Methodology

For forecasting the petroleum potential of Lower Jurassic terrigenous deposits, it is necessary to create a geological model of Lower Jurassic deposits with identification of prospective zones for exploration of new hydrocarbon deposits. For this purpose, to study the sedimentation process, rock composition, degree of enrichment in dispersed organic matter, identification of sandy horizons, and characterization of their reservoir properties, materials from seismic surveys in 2D-CDP and 3D-CDP modifications, electrical prospecting materials, a complex of well logging data, and laboratory studies of core and

cuttings from deep reference, parametric, and exploration wells that penetrated Lower Jurassic deposits in the territory of the Ustyurt petroleum region were used. During the work, a reflecting horizon was identified, confined to the top of Lower Jurassic deposits, and within the volume of penetrated rock thickness, productive horizons were identified and their correlation was performed, which represent sandy packages, both laterally consistent and lenticular (Yuldasheva, 2024). The work employed the method of facies analysis of sedimentary formations and integrated biorhythm stratigraphic subdivision and correlation of sections. It should be noted that the territory is covered by exploration work extremely unevenly; therefore, the level of detail of studies varies: from regional generalization to local forecasting.

Analysis

The comprehensive study of Lower Jurassic deposits in the Ustyurt petroleum region reveals a highly heterogeneous and structurally complex sedimentary system, which significantly influences hydrocarbon potential. The integration of lithological, stratigraphic, paleo geographic, and geochemical data indicates that while earlier exploration considered these deposits as simple containers for hydrocarbons, subsequent investigations have demonstrated the presence of multi-tiered sandstone packages interbedded with impermeable clay-mudstone sequences. These packages display variable thicknesses, filtration properties, and lateral continuity, emphasizing the importance of detailed facies and reservoir analyses to identify commercially productive horizons and anticipate zones of weak flow or pinch-outs (Yuldasheva, 2024; Abdullaev et al., 2019).

Structural interpretations based on 2D and 3D seismic surveys, coupled with well-log and core analyses, underscore the role of tectonic features such as anticlinal traps, screened faults, and paleo rift zones in controlling hydrocarbon accumulation. Commercial gas-condensate flows from fields such as Kuanysh, Akchala, and Eastern Barsakelmes validate the predictive power of these geological models. Moreover, geochemical investigations confirm the presence of indigenous source rocks capable of generating hydrocarbons, which, together with lateral migration from adjacent formations, account for variations in productivity across the region (Yuldasheva, 2019; Mukhutdinov et al., 2019).

Finally, the analysis highlights the critical influence of depositional environment and paleogeography on reservoir quality. The differentiation of ancient uplands, deluvial-proluvial belts, lacustrine-paludal zones, and alluvial plains has led to a mosaic of facies with distinct porosity and permeability characteristics. This sediment logical and tectono-stratigraphic complexity necessitates integrated exploration approaches, combining seismic interpretation, geochemical assessments, and core analysis to accurately delineate productive horizons and optimize hydrocarbon recovery in the Ustyurt Basin (Boykobilov et al., 2008; Yuldasheva, 2022)

Findings and Discussion

At the initial stage, Lower Jurassic deposits were studied in reference and parametric wells, in which lithological and stratigraphic features, rock age, and reservoir properties were determined; the identified complex was tied to a reflecting seismic horizon. In 1967, the Kuanysh gas condensate field was discovered in Lower Jurassic deposits, whereas the structure had been prepared based on the top of Middle Jurassic deposits. Subsequently, work was conducted to prepare structures based on the reflecting horizon

T_{IV-II}, confined to Lower-Middle Jurassic deposits, which was actually confined to a mudstone package of the Bajocian-Bathonian stages of the Middle Jurassic. The commercial flows of gas with condensate obtained in Lower Jurassic deposits (Akchala, Eastern Barsakelmes, Kuanysh fields) led to the need to pay attention to the structure of these deposits with the aim of identifying and preparing structures for drilling. One of the first structures prepared based on Lower Jurassic deposits was the reservoir-type anomaly (RTA) Kokchalak, which is represented by a non-structural lenticular screened trap in channel sandstones, from which commercial flows of gas and condensate were obtained (Yuldasheva, 2024).

Subsequently, in the early 2000s, as a result of 2D-CDP and 3D-CDP work, a series of structures was prepared based on Jurassic horizons, including Lower Jurassic deposits on the Kuanysh-Koskala swell (Tillali), in the Sudochye trough (Porlytau), the Barsakelmes trough (Eastern Atorbay, Northern Atorbay, Shumanay, etc.), and in the Kosbulak trough (Sulama, Ak-Tepe, Western Aral, etc.). All structures in Lower Jurassic deposits represent either anticlinal structures or tectonically screened traps adjacent to faults (Abdullaev et al., 2019, Yuldasheva, 2024).

The next stage in studying Lower Jurassic deposits was the deepening of the investigation interval. Based on the results of previously performed work, it became evident that the deposits of the Lower Jurassic complex beneath discovered fields were insufficiently studied. For example, during exploration work at the Shakhpakhty, Urga, Aral, Berdakh, Northern Berdakh, and Surgil prospects, in the first exploration wells from Lower Jurassic deposits, weak gas flows were obtained, often with formation water, which subsequently proved to be the result of possible facies and lithological replacement, confinement to pinch out zones and deterioration of reservoir properties, not only of natural origin but also created by technological conditions of well drilling (Yuldasheva, 2024).

At the initial stage of developing Lower Jurassic deposits, when territories were being studied where small thicknesses of deposits of this age were penetrated (100-400 m), a conclusion was made that these deposits, mainly composed of sandy sediments, are merely containers for hydrocarbons. However, because of further geological exploration work, territories were identified where Lower Jurassic deposits compose thick sequences (up to 2 km and more), consisting of sandstone packages separated by relatively impermeable clay-mudstone sequences, the number of which varies depending on tectonic confinement. Moreover, productive and potentially productive horizons are represented by fine-pebble to sandy rocks of various mineral compositions and filtration-capacitive properties. The peculiarities of sedimentation of the Lower Jurassic terrigenous formation determined the facies diversity of its structure depending on thickness magnitude (Yuldasheva, 2022, 2024).

The Jurassic stage of sedimentation within the Ustyurt region began after a prolonged break that continued throughout the Middle and Late Triassic, when a dissected erosional-tectonic relief was formed, the deep depressions of which began to rapidly fill with coarse clastic deposits of molasse type, for example within the eastern part of the Sudochye trough. As a result, negative forms of paleo relief were filled with the most ancient Jurassic formations, while on elevated areas (Central Ustyurt and Koskala paleo uplifts) sedimentation began only in Middle Jurassic time. In Early Jurassic time, five paleogeographic zones are distinguished, reflecting changes in sedimentation conditions:

ancient uplands, deluvial-proluvial belts, lacustrine-paludal territories, alluvial plains, and paleo rift zones (Fig. 1).

Ancient uplands were located in the central part (Aktumsuk paleouplift), in the south (Central Ustyurt and Koskala paleouplifts), and in the southeast (Kyzylkum) of the territory, which are characterized by rather dissected relief, where denudation processes were actively occurring, resulting in the formation of material for removal, and on adjacent territories extensive deluvial-proluvial belts accumulated around them (Boykobilov et al., 2008). In all wells drilled within their limits, at the Terengkuduk, Kharoy, Sarytekiz, Kassarma, Bayterek, Kokbakhty, and Aybugir prospects, Lower Jurassic rocks are absent.

It should be noted that the southern part of the Aktumsuk paleouplift represented a denudation scarp that steeply dropped toward the intraplatform Kulbai graben-like trough, which was intensively filling with deluvial-proluvial formations, including possibly colluvial ones, as evidenced by the thick Lower Jurassic sections in the Northern Dzhangyzsu and Razlomnaya wells, in whose section the C_{org} content in black silty mudstones reaches 13.5%, and chloroform bitumen "A" (ChBA) - 0.3%, which indicates the presence of allochthonous bitumoids in the host sequence.

Extensive near-slope territories are covered by deluvial-proluvial belts, which frame all the above-mentioned ancient uplands; particularly extensive fields of these are noted in the territory of southern Priaralye and the southern part of the Barsakelmes trough. Deposits of the deluvial-proluvial complex are usually represented by interbedding of clays (mudstones), siltstones, sandstones, gravestones, and conglomerates; lenticular interlayers of mixed, unsorted, sandy-silty-clayey rocks are occasionally encountered, whose composition depended on the relief of nearby source areas and the composition of their constituent rocks. In confirmation of this fact, cores show widespread occurrence of coarse clastic sandstone-conglomerate rocks composed of fragments of various types of Late Palaeozoic rocks.

On the northern slopes of the Aktumsuk paleouplift, the relief was less dissected, the deluvial-proluvial rock complex is more homogeneous in composition, with sandy deposits predominating. It is assumed that the southern slope was higher and steeper, while the relatively gentle surface of the watershed and adjacent slope was inclined to the northwest.

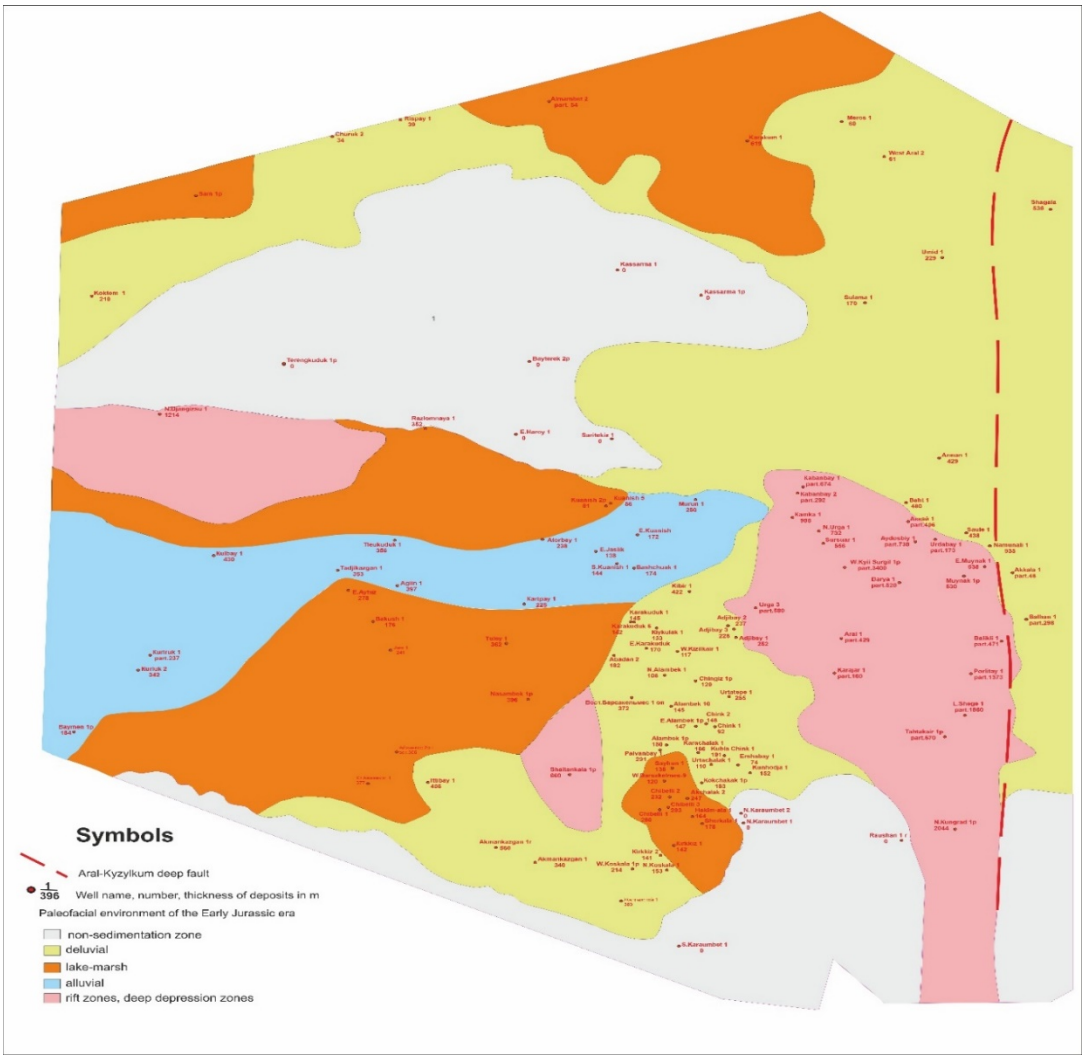

Figure 1: Paleofacies map of the Early Jurassic epoch of the central part of the Ustyurt region. Compiled by M.G. Yuldasheva using data from Boykobilov, Khaitov, Dzhalilov, 2008.

Their attribution to the deluvial-proluvial type is evidenced by the absence of sorting, low degree of rounding, and angularity of clastic material. Lacustrine-paludal territories and alluvial plains were widely distributed in the Early Jurassic epoch within the central part of the Barsakelmes trough and in the northern areas of the Samsky and Kosbulak troughs.

In the zone of lacustrine-paludal territories of the Barsakelmes trough, rocks formed that are characterized by irregular alternation of sandy-clayey sediments, where clayey varieties occur in the upper part. A characteristic feature is the inclusion of pyrite crystals and numerous carbonized plant detritus in the form of interlayers, plant impressions, interlayers of black coals; stratification is observed, which indicates lacustrine-paludal sedimentation conditions. On the southern flank of the Barsakelmes trough, according to chemical-bituminological studies, the presence of potential petroleum source rocks in the Lower Jurassic complex is also noted; elevated organic matter content in siltstones is observed at approximately 1.32...3.17%, chloroform bitumen "A" comprises 3.9-5.71% of autochthonous character. Thus, it can be concluded that the possibility of Lower Jurassic productivity cannot be excluded, especially since the thicknesses of these

deposits according to seismic data increase significantly (up to 700-800 m) (Yuldasheva, 2019)

The presence of zones of alluvial plains in Early Jurassic time is noted in the Kosbulak and Barsakelmes troughs. In lithological terms, this complex of ancient river networks is represented by sandy deposits of various grain sizes, predominantly medium- to coarse-grained, containing numerous inclusions of black-colored organic matter unevenly distributed in the rock; inclusions of well-rounded gravel are observed in the basal part.
At the boundary between the Triassic and Jurassic periods, a transitional stage in the geotectonic and geodynamic development of the region under consideration was ending, and the formation of the sedimentary cover of the Turan Plate was beginning. Therefore, partial inheritance was preserved in the development of some structural elements, such as, for example, the graben system (Davlyatov et al., 1987). Two such structures continued to exist and intensively subside at high rates in the area of the southern flank of the Aktumsuk paleouplift and west of the Aral-Kyzylkum deep fault. They represented deep canyons in which Jurassic sedimentation began much earlier, as evidenced by the features of rocks filling these grabens, which are represented by clastic materials: sandstones of various grain sizes, more often medium- and coarse-grained, with interlayers of gravelstones and conglomerate-gravelstones, and black coals.

Moreover, in territories where the penetrated thickness of the Lower Jurassic exceeds 900 m, the oldest penetrated deposits are rocks including undivided formations of the upper Rhaetian, Hettangian, Sinemurian, and Pliensbachian. In the rest of the territory, the Lower Jurassic section is represented by a sequence of Toarcian age.

The second "graben-paleorift" zone is located within the Sudoch trough system, northwest-trending and deeper in intensity. In the eastern part, it lies beneath the Berdakh swell (Fig. 2), and in the western part, it lies directly in the central part of the Sudoch trough, where a large graben has been recorded.

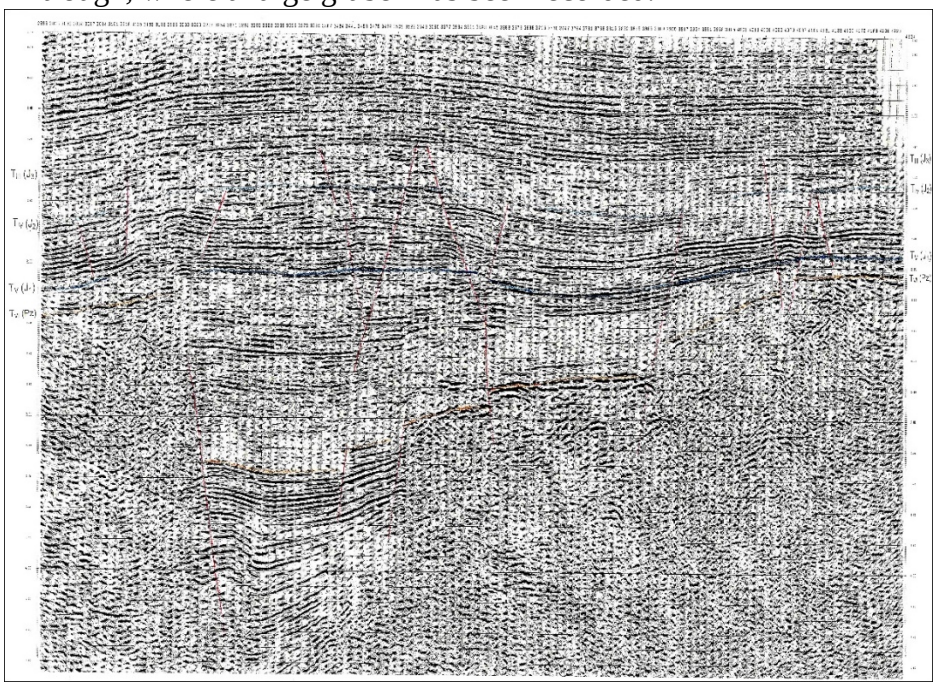

Figure 2: Fragment of a time section through the graben-paleorift in the western part of the Sudochye trough

In this territory, the Lower Jurassic is characterized by maximum stratigraphic completeness compared to other areas of the Ustyurt region. The lower half of the section includes undivided formations of the Rhaetian, Hettangian, Sinemurian, and Pliensbachian, while the upper intervals are composed of rocks of the Toarcian stage. From this, it can be concluded that it was established even in pre-Jurassic time, while its intensive filling began, probably, even in Triassic time. Here, rhythmic alternation of sandstones, siltstones, and mudstones is observed. In the composition of the Toarcian stage, interlayers of gravelstones and conglomerates appear.

In territories where the thicknesses of Lower Jurassic deposits vary within 250...400 m (Kuanysh-Koskala swell, Agyin uplift, Sudochye trough, etc.) and the sequence is represented by coarse-grained sandstones isolated by small interlayers of clays and mudstones, among which four productive horizons were identified that are confidently traced throughout the entire swell territory. However, it should be noted that in the central part of the Kuanysh-Koskala swell, the Lower Jurassic productive sequences consist of three beds, while in the slope parts the presence of four productive beds is noted. Moreover, the highest flow rates of gas and condensate are recorded in the basal part of the section and near the contact with underlying Upper Paleozoic formations and adjacent zones of increased thicknesses of coeval terrigenous deposits enriched in dispersed organic matter. Thus, petroleum occurrence is determined both by vertical migration of hydrocarbons from underlying sedimentary complexes of the Upper Paleozoic and by lateral migration from adjacent grabens composed of clayey Lower Jurassic sediments, while hydrocarbon accumulations were discovered in anticlinal structures, often tectonically screened.

Within the marginal parts of large troughs (Kosbulak, Barsakelmes), where increased thicknesses of Lower Jurassic deposits are predicted and partially confirmed, which are confined to regional faults where sharp changes in the facies composition of deposits also occur. Their overlying by younger clayey sediments creates very favorable conditions for the formation of lithological and stratigraphic traps of non-anticlinal type. Lower Jurassic deposits within the block, especially in the southern part of the Barsakelmes trough and other subsided areas of troughs, occur at considerable depths (2...3 km), have significant thicknesses, and are characterized by geothermal gradients of 3.4...3.6°C/100 m. All this can ensure significant scales of hydrocarbon generation. This factor is supported by data according to which Lower Jurassic deposits accumulated under reducing and weakly reducing sedimentation conditions, which is confirmed by the presence of pyrite and siderite inclusions. Chemical-bituminological studies established elevated organic matter content in clays of 0.77%, in siltstones and sandstones up to 3.17%, and chloroform bitumen "A" throughout the sequence comprises 3.9...12.7%, which is of autochthonous character. It can be concluded that in the southern direction, within the Barsakelmes trough, the possibility of Lower Jurassic productivity cannot be excluded, where the thicknesses of these deposits according to seismic data increase to 700-800 m (Yuldasheva, 2019).

The greatest thickness of Lower Jurassic deposits is predicted on the Berdakh swell, which according to geophysical data amounts to 4000...5000 m, where the productivity of the entire Jurassic section has been proven. Special sedimentation conditions determined a sufficiently large diversity of sandy beds of various thicknesses, configurations, and filtration-capacitive properties (Fig. 3). In this territory, only in the upper part of Lower Jurassic deposits, covering 900 m of penetrated thickness, up to 12

productive horizons have been identified, occurring to a depth of minus 4450 m, which form both thin and sufficiently massive sand bodies (up to 50-100 m).

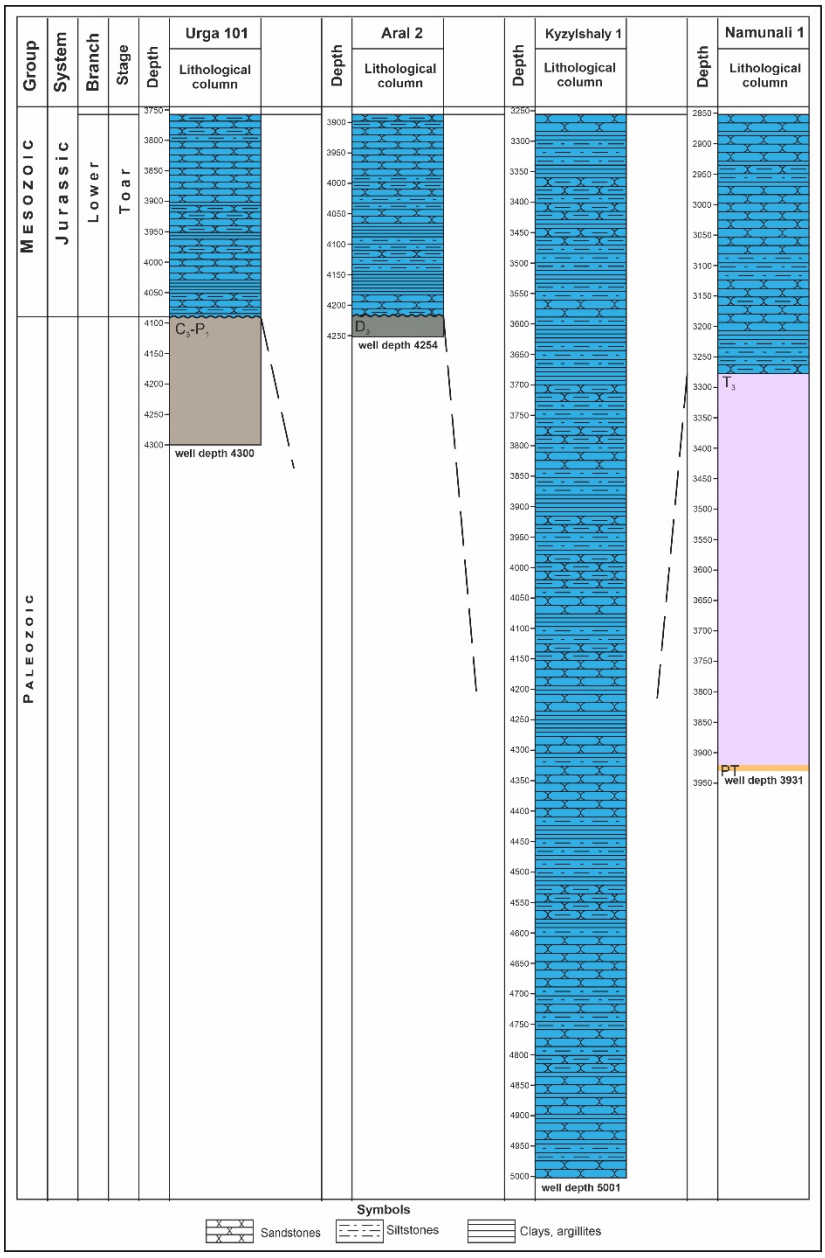

Figure 3: Examples of penetrated sections of Lower Jurassic deposits of the Sudochye trough, the Berdakh swell and the Muynak uplift

Reservoirs are represented by sandstones and gravelstones possessing good filtration-capacitive properties (porosity ≈10...16%) while forming both thin and sufficiently massive sand bodies (up to 50...100 m). With depth, sandstone porosity decreases somewhat to values of 8-10%, but fracturing appears, which increases rock permeability (Yuldasheva, 2019, 2022).

Clayey rocks (mudstones and siltstones) have good sealing properties and, in addition, possess generation properties, having in their composition a sufficient amount of dispersed organic matter, which at depths of 3020 m...4027 m varies from 0.25 to 1.43%.

The highest C_{org} values (3.93-5.74%) are noted in black mudstones at the Arslan field at depths of 3470 m...3472 m, and from a depth of 3500 m microbitumen manifestations are noted (ChBA above 0.065%), which allows forecasting an indigenous source of hydrocarbon generation (Mukhutdinov, Yuldasheva, Akramova et al., 2019). Moreover, in the marginal parts of the swell, the greatest productivity is noted in the upper five horizons; with depth, hydrocarbon flow rates decrease. In the central and southern parts of the swell, an inverse relationship is observed, i.e., with depth flow rates increase, reaching values up to 800-1400 thousand m^3/day, where the influence of tectonic disturbances is noted, contributing to improvement of reservoir properties, while in the upper analog beds, where bed continuity is not disturbed, only signs of hydrocarbon saturation in the form of weak gas flows were obtained (Yuldasheva, 2022).

In addition to the established commercial gas occurrence, it should be noted that signs of oil occurrence have been obtained in Lower Jurassic deposits. At the Karakuduk prospect, non-commercial flows of light, low-sulfur, and low-gasoline oil were obtained. In the northern part of the Garbiy Borsakelmas gas condensate field, from Lower Jurassic sandstones, oil flows were obtained that are similar in density, sulfur content, and gasoline fractions to the oil from the Karakuduk prospect. In the eastern part of the North Ustyurt depression, at the Eastern Muynak prospect, a non-commercial flow of light, low-sulfur, gasoline-type oil was obtained from Lower Jurassic sandstones (Yuldasheva, 2024).

Lower Jurassic deposits of the Ustyurt region have a very complex geological structure that depends on sedimentation conditions, which was not previously taken into account when conducting exploration work. For example, it was assumed that the thicknesses of these deposits were consistent throughout the entire territory of the Barsakelmes trough (Boykobilov et al., 2008); in fact, it has been established that there are zones with increased thicknesses in the southern and northern parts of the territory. The conclusion about unfavorable conditions for the formation of Lower Jurassic reservoir rocks and low filtration-capacitive properties was made based on core analyses [14], which represents a point value but was interpolated to the entire territory of northern Ustyurt. It was also determined that the Lower Jurassic section is composed of sandy beds with good reservoir properties only in the upper part, while the prevailing role is played by fine-grained and pelitic formations, which is the reason for obtaining weak gas flows (Gafarov et al., 2010, Lyugay et al., 2010, Krylov et al., 2015). However, it was established that in the studied sections of Lower Jurassic deposits of the Berdakh swell, sandstones have porosity of 10...15%, and with depth fracturing appears. In addition, the presence of gas source rocks was established within the composition of this rock complex, which indicates the generation capabilities of Lower Jurassic deposits, which was previously excluded (Abdullaev, Yuldasheva, 2019, 2024).

Conclusion

Based on the study of sedimentation conditions of Lower Jurassic deposits of the Ustyurt region, new data have been obtained on the structure of Lower Jurassic deposits, whose productivity to date has been proven in the zone of increased thicknesses of the Berdakh swell and Sudochye trough, where a multi-tiered system of sandy horizons has formed, confirmed by the discovery of gas condensate accumulations. This zone is confined to an

ancient paleorift in which an independent petroleum system has formed that extends in a southern direction.

Within the Ustyurt region, analogous territories have been identified within the Takhtakair swell, Taldyk trough, the junction zone of the Berdakh swell and the Muynak uplift, in the southeastern and northern parts of the Barsakelmes trough, where geological exploration work needs to be carried out with an increase in the depth of research to 6-7 km marks, both seismic work and deep drilling.

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Publicistic Poetics in Karakalpak Journalism: Theoretical Foundations and Stylistic Manifestations

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Abstract

The concept of publicistic poetics remains contested within journalism studies, with some scholars restricting poetics exclusively to the domain of fiction literature. This article addresses the theoretical gap by arguing that poetics is not confined to literary studies but is equally operative within journalistic and publicistic discourse.

Keywords: Figurative Language, Journalistic Genres, Karakalpak Journalism, Media Discourse, Publicistics, Poetics, Publicistic Poetics, Stylistics

Introduction

The question of whether the concept of poetics applies exclusively to fiction literature or extends to journalistic and publicistic writing has generated ongoing scholarly debate, particularly within post-Soviet media studies. A number of journalism practitioners tend to confine poetics to the literary domain, thereby denying its relevance to journalistic discourse. This position, however, rests on a narrow understanding of both poetics and publicistics.

Publicistics—understood as a distinct mode of discourse that combines the informational imperatives of journalism with the expressive resources of literary language—has long been recognised as a sophisticated communicative practice. As several journalism scholars in post-Soviet republics have argued, publicistics is a broader concept than journalism per se, one that systematically employs the full range of linguistic and rhetorical possibilities available to the art of speech (T.Masharipova, 2016; F.Muminov, 2010).

Despite this recognition, the theoretical concept of publicistic poetics has received insufficient systematic attention in the context of Karakalpak journalism. Existing scholarship tends either to treat poetics as the exclusive property of literary studies or to discuss journalistic style in purely functional terms, without engaging with the poetic dimensions of publicistic texts. This article addresses that gap.

The study pursues three interconnected objectives: (1) to establish a theoretically grounded definition of publicistic poetics that distinguishes it from both general poetics and journalistic style; (2) to identify the principal dimensions along which publicistic poetics operates; and (3) to substantiate these dimensions with textual evidence drawn from Karakalpak periodical publications.

The present research contributes to the broader project of developing a national framework for Karakalpak media studies and positions that tradition within the wider field of international journalism scholarship.

Review of Related Literature

The scholarly literature on publicistics and poetics demonstrates a long tradition of examining journalism, rhetoric, and literary expression across Russian, Uzbek, and Karakalpak contexts. Foundational works such as Solganik (1990) and Styuflyaeva (1975) established the theoretical basis of the poetics of publicistics, while later contributions by Kaida (2016, 2022) expanded this into compositional analysis of texts. Studies like Popova & Silantyev (2011) and Prokhorov (2013) highlight the artistic-publicistic unity, showing how journalistic discourse blends literary and rhetorical strategies. Similarly, Kuznetsov (2008) situates publicistics within historical rhetoric, emphasizing its persuasive and cultural functions.

Regional scholarship enriches this tradition. In Kazakhstan and Karakalpakstan, Kalkabaeva (2019) and Kamzin (2015) explored literary poetics and the evolution of publicistic genres, while Ja'rimbetov (2012) and Nurzhanov (2008) examined stylistic features of modern Karakalpak literature. Uzbek contributions, such as Muminov (1998) and Khudoykulov (2011), focused on journalistic methods and the relationship between journalism and publicistics. More recent works, including Masharipova (2020, 2024), propose integral concepts and practical frameworks for publicistics theory, reflecting contemporary academic discourse in Nukus.

Classical references, such as Aristotle's Poetics and encyclopaedic dictionaries (1981, 1987, 2006), provide the philosophical and linguistic foundation for understanding poetics across traditions. Folklore studies by Lazutin (1989) further illustrate the cultural depth of publicistic expression. Collectively, these sources reveal that publicistics is not merely journalistic practice but a complex literary and rhetorical phenomenon, evolving through historical, cultural, and regional contexts while maintaining its role as a bridge between literature and social discourse.

Objectives

The objectives of this study are to define publicistic poetics in a way that distinguishes it from general literary poetics and from journalistic style, thereby clarifying its theoretical foundation. It seeks to identify the principal dimensions along which publicistic poetics operates, such as its linguistic, rhetorical, and expressive functions. The research also aims to substantiate these dimensions through analysis of Karakalpak periodical publications, offering concrete examples of how poetic elements manifest in journalistic discourse.

Ultimately, the objectives are to fill the scholarly gap by systematically addressing the poetic dimensions of publicistics in Karakalpak journalism. The study intends to contribute to national media studies by developing a framework that situates Karakalpak publicistics within international journalism scholarship, thereby strengthening its theoretical and practical relevance in both local and global contexts.

Methodology

The study of poetics in relation to journalism and publicistic writing has a substantial, if uneven, scholarly lineage. Institutionally, the integration of poetic and rhetorical theory into journalism education is exemplified by the long-running course 'The Rhetorical and Poetic Foundations of Journalistic Genres,' taught at the Faculty of Classical Journalism, Novosibirsk State University, authored by Popova and Silantyev [1]. The existence of such a course attests to a broader scholarly consensus that rhetorical and poetic categories are not foreign to journalistic analysis.

Among the foundational works in the field, Solganik's Publicistic Poetics [2] provides an early systematic account of how poetic principles organise journalistic texts. Styuflyaeva's monograph of the same title approaches the subject from a stylistic perspective, while Kaida's Compositional Poetics in Publicistics [3] and The Compositional Poetics of the Text develop the structural dimensions of publicistic organisation. Nurbut's study of K. Simonov's wartime publicistics [4] demonstrates how poetic analysis can illuminate a specific historical corpus of journalistic writing. Kuznetsov's Historical Rhetoric [5] situates publicistic expression within a longer rhetorical tradition, and Prokhorov's work on the poetics of artistic-publicistic unity [6] explores the interplay of literary and journalistic modes. Within Central Asian scholarship, Kalkabaeva's The Poetics of the Artistic Work [7] and Kamzin's The Evolution of Publicistic Genres [8] extend these concerns into the Kazakh media context. From a theoretical standpoint, the general method of journalism has been defined by Uzbek media scholar F.Muminov as 'operational relevance and social reflection' [10]. Building on this, T,Masharipova specifies the general method of publicistics as 'operational relevance and expressive social reflection,' emphasising that publicists are obliged to write with vividness, emotionality, and expressiveness [11, 12]. This formulation is significant because it locates expressive quality—a property traditionally associated with literary and poetic language—at the heart of publicistic practice.

Definitions of poetics itself are characterised by considerable breadth. The Literary Encyclopedic Dictionary defines poetics as 'one of the oldest branches of literary studies, concerned with the system of artistic devices in literature' [14]. P.Nurzhanov, in his monographic study of contemporary Karakalpak literature, traces the historical expansion of the term, noting that poetics has come to encompass 'issues of artistry and creative mastery,' as well as 'the ideological and aesthetic particularities of literature, its system of expressive means, the dominant genre and stylistic movements of a given literary process, the inner structure of creative works, the beauty of their composition and plot, the nature of conflicts, and the distinctive qualities of language and style' [16]. This broad conception—extending well beyond the narrow identification of poetics with prosodic analysis or genre taxonomy—opens the field to application across a range of discursive practices, including journalism.

The Poetics of Russian Folklore makes the further point that poetics concerns 'the principles and methods through which reality is reflected, and the theoretical categories of a particular art form' [25]. This formulation is directly relevant to publicistics, since faithful and clear representation of social reality is constitutive of journalistic practice. Taken together, these theoretical perspectives support the claim that a distinct subdiscipline of publicistic poetics is both conceptually warranted and analytically productive.

This study adopts a qualitative approach grounded in textual analysis. The methodological framework integrates three complementary traditions: (1) literary poetics, particularly as developed in post-Soviet scholarship; (2) rhetorical theory, including classical and contemporary accounts of persuasive discourse; and (3) journalism studies, with particular attention to the concept of publicistics as a distinct mode of mediated communication.

Primary source materials consist of selected articles, essays, portrait sketches, and lyrical publicistic works published in Karakalpak daily and literary periodicals between 2001 and 2022, principally in Erkin Karakalpakstan, Nukus Khakikaty, and Karakalpak Literature. These texts were selected to represent a range of journalistic genres and to illustrate the diversity of poetic devices operative in Karakalpak publicistic writing. The analytical procedure involved close reading of selected texts with attention to the following dimensions: titling strategies and their rhetorical effects; figurative language (imagery, metaphor, comparison, allusion); compositional organisation and narrative structure; the interplay of rational and emotional argumentation; and intertextual relationships between texts and between texts and their social context. Findings were interpreted against the theoretical background established in the literature review and elaborated into a taxonomy of publicistic poetics.

The study does not employ quantitative content analysis or corpus methods; its contribution is theoretical and interpretive rather than descriptive. Generalisability is accordingly qualified: the analysis is offered as a conceptually grounded account of publicistic poetics as manifested in one national journalistic tradition, with implications for the comparative study of publicistic discourse more broadly.

Analysis

Conceptual Foundations: Distinguishing Publicistic Poetics

The results of the theoretical analysis support a working definition: publicistic poetics is the study of the system of expressive, figurative, and compositional devices through which journalistic and publicistic texts generate emotional, aesthetic, and ideological meaning. This definition differs from literary poetics in two important respects. First, publicistic poetics operates under the constraint of factual fidelity: unlike fiction, publicistic writing cannot arbitrarily reshape reality for aesthetic purposes but must engage with verifiable events and social phenomena. Second, publicistic poetics is characterised by an orientation toward immediate social and political intervention—what Masharipova calls 'critical design of reality' [11]—rather than toward autonomous aesthetic experience.

The distinction from general journalism theory is equally important. Journalism's general method—operational relevance and social reflection—is a necessary but not sufficient condition for publicistic poetics. What distinguishes publicistics is the additional requirement of expressive social reflection: the journalist must not merely report but must render reality in a vivid, emotionally resonant, and argumentatively compelling form. This is the ground on which poetics enters journalism.

A further key distinction concerns the degree of authorial subjectivity. In standard news reporting, objectivity functions as a regulative ideal: the journalist aims to minimise personal involvement and present events neutrally. In publicistic writing, by contrast, personal involvement is not a defect but a constitutive feature. The publicist's perspective,

emotional investment, and civic commitment are part of the communicative content of the text. This elevated subjectivity creates the space in which poetic devices—imagery, rhythm, metaphor, rhetorical address—become not merely ornamental but structurally necessary.

Dimensions of Publicistic Poetics

The analysis identifies five principal dimensions along which publicistic poetics operates. Each is illustrated below with reference to the Karakalpak press.

Figurative Poetics

The image (obraz) constitutes the fundamental unit of publicistic poetics. In publicistic writing, images are generated not through sustained fictional narrative but through the skilled deployment of facts, details, metaphors, comparisons, and allusions. The image functions not merely as decoration but as a vehicle for emotional intensification: it transforms abstract social facts into concrete experiential realities for the reader.

The Karakalpak publicistic tradition provides numerous examples of sustained figurative writing. The works of T.Qayipbergenov, particularly his problem-focused essays such as 'The Image of Generosity' and 'The Apple of the Eye,' deploy figurative language to illuminate social conditions that straightforward reporting would leave inert. Similarly, the poetic publicistics of I.Yusupov—notably 'Elegies of the Aral' and 'This Land Will Be Great'—mobilise lyrical imagery to address the ecological catastrophe of the Aral Sea's recession, transforming environmental reportage into a form of civic elegy. O.Abdirakhmanov's documentary work, including the three-part film 'Aralkum,' extends figurative publicistics into the audiovisual domain, demonstrating that the principles of publicistic poetics are not confined to print.

Genre Poetics

Different journalistic genres possess distinct poetic systems. The essay favours narrative elaboration and character portraiture; the reportage privileges dynamism and dramatic immediacy; the lyrical essay tends toward philosophical imagery and subjective reflection. These genre-specific poetic structures are not arbitrary but reflect the communicative functions and audience expectations associated with each genre.

Genre poetics is observable in the range of publicistic forms represented in the Karakalpak press: problem-focused essays, portrait sketches, lyrical publicistics, philosophical essays, and documentary film. The diversity of these forms reflects not merely differences in topic or occasion but systematic differences in the poetic means through which social reality is mediated.

Stylistic Poetics

Publicistic style ranges from the elevated and pathos-laden to the satirical and ironic. Stylistic figures—metaphor, anaphora, epithet, rhetorical question, inversion—constitute the rhetorical toolkit of the publicist, generating expressiveness and reinforcing the author's civic voice. Stylistic poetics is concerned with how these figures are selected, combined, and deployed in relation to the rhetorical situation.

A particularly instructive example is provided by the contrast between clichéd and creative titling practices in the Karakalpak press. Articles about educators frequently employ formulaic epithets—'great teacher,' 'progressive-minded teacher,' 'visionary

scholar'—that have lost their expressive force through overuse. In contrast, titles such as 'Reverence to the Teacher' (Ustazg'a tawbe etiw) (Khudaibergenov, Erkin Karakalpakstan, 2001), 'He Was Like a Commander of Ballet Masters…' (Baletmeyster sardari bolg'anday edi…) (Orazov, Erkin Karakalpakstan, 2007), and 'To Be Ansatbayev Was Never Easy…' (Kimsen, An'satbaev boliw an'sat bolmag'an…) (Khojamuratova, Nukus Khakikaty, 2017) deploy unexpected comparisons, ellipsis, and rhetorical suggestion to create genuine curiosity and affective engagement. The difference between these stylistic registers is not merely aesthetic but ideological: clichéd praise may undermine journalistic credibility, while creative stylistic choices signal genuine intellectual engagement with the subject.

Compositional Poetics

The structure of a publicistic text is governed by poetic principles analogous to those operative in literary composition. Exposition, development, climax, and resolution are present in the best publicistic works, as are recurring motifs, tonal shifts, and narrative voice. Compositional poetics examines how the internal organisation of a text enhances or undermines its communicative and affective goals.

Findings and Discussion

An extended example of compositional sophistication is provided by the paired articles on Allayar Dosnazarov, the foundational figure of Karakalpak statehood. A. Khalmuratov's 'Allayar Dosnazarov—The First!' (Allayar Dosnazarov – birinshi!) (Erkin Karakalpakstan, 2001) employs the emphatic numeral and exclamation mark to make a bold historical claim. Twelve years later, Sh. Usnatdinov's 'Allayar the Second' (Allayar ekinshi) (Erkin Karakalpakstan, 2013) implicitly responds to Khalmuratov's framing, using the numeral 'second' to evoke the prior existence of a 'first' Dosnazarov and thereby reinforce the historical continuity of a civic tradition. The compositional relationship between the two texts—across time and across authorship—demonstrates that publicistic poetics can operate at the level of intertextual sequence, not only within individual works.

Intertextuality and Aesthetics

Publicistic texts are embedded in a web of intertextual relations—with prior texts, with shared cultural memory, and with the broader discursive field of their moment. Intertextual poetics analyses how publicistic writing draws on, responds to, and transforms these relations. A journalist's allusion to a historical figure, a literary reference, or a prior article in the same newspaper activates a complex network of associations that enriches the communicative content of the text beyond its explicit propositional content.

The Dosnazarov sequence illustrates intertextuality at work. A. Khabipov's article 'They Remained Unburied…' (Olar komiwsiz qalg'an edi…) (Erkin Karakalpakstan, 2001), published under the rubric 'Wounds That Remain in the Heart,' invokes the same historical figure in a context of patriotic mourning, building on readers' prior familiarity with the narrative of Karakalpak statehood. The cumulative effect of these intertextually related texts is a richly layered publicistic conversation that exceeds the scope of any individual article.

The Rationality–Emotionality Dialectic

A recurring theme in the analysis is the productive tension between rational and emotional modes of argumentation in publicistic writing. Rationality in publicistics is manifested in topic selection, fact gathering, systematic comparison and analysis, argument

substantiation, and fact verification. Emotionality is manifested in the deployment of imagery, personal voice, affective appeals, and rhetorical figures. The distinctive quality of publicistic writing—as opposed to both neutral news reporting and purely literary fiction—lies in the systematic integration of these two modes.

As the analysis shows, effective publicistic writing neither reduces to dispassionate information transmission nor abandons factual grounding in favour of pure affect. The comparison of a public figure to a historical hero such as Aydos biy or Ernazar Alakoz is a form of imagery that carries emotional force; the accompanying factual characterisation provides rational grounding. When these two elements interact dynamically within a text, the result is a communicative form capable of both informing and persuading—of conveying facts while simultaneously engaging the reader's civic imagination.

Conclusion

This study has argued for the theoretical legitimacy and practical significance of publicistic poetics as a distinct subdiscipline of journalism studies. Drawing on a broad range of theoretical frameworks and on close textual analysis of Karakalpak journalistic writing, the article has identified five principal dimensions of publicistic poetics—figurative, genre, stylistic, compositional, and intertextual—and has demonstrated their concrete manifestation in a specific national journalistic tradition.

The findings carry several implications. Theoretically, they support a non-restrictive account of poetics according to which poetic properties are not the exclusive domain of fiction but are constitutively operative in any sophisticated linguistic practice oriented toward expressive and persuasive communication. Practically, they suggest that the tools of poetic analysis can and should be incorporated into journalism education and media criticism, not as a literary luxury but as a means of understanding the full communicative range of journalistic texts.

The specific features of publicistics—topicality, operativeness, actuality, and public engagement—are not external constraints on publicistic poetics but its generative conditions. It is precisely because publicistic writing must engage with immediate social reality, respond rapidly to events, address socially significant concerns, and reach broad publics that it develops the distinctive poetic resources documented in this study. Publicistic poetics is, in this sense, a poetics of civic commitment.

Future research should extend this analysis to digital and multimodal publicistic forms, to the comparative study of publicistic poetics across different national and linguistic traditions, and to the historical development of Karakalpak publicistic writing across the twentieth and twenty-first centuries. The present study offers a theoretical framework and a set of analytical tools that can support such future investigations.

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Examining the Impact of User-Generated Imagery on Professional Photojournalism: Practice, Ethics, and Visual Culture

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Abstract

User-generated imagery (UGI) is important in professional photojournalism as it offers real-time pictures that expand news coverage and modify newsroom procedures. However, it also raises questions about authenticity and media ethics. The purpose of this research was to examine the impact of UGI on professional photojournalism, with a focus on newsroom practices, ethical issues and visual culture. The researcher used a mixed-method, cross-sectional research design to evaluate both quantitative and qualitative data. Data from professional photojournalists of Chinese media organisations were gathered using convenience-sampling method. The research used structured questionnaires to collect responses from 500 individuals and conducted semi-structured interviews with 113 participants. The relationship between variables was investigated using Analysis of Variance, while patterns and qualitative insights were identified and interpreted utilising thematic analysis. The results showed that UGI has changed photojournalism by improving audience engagement with instant and relevant visual content. Nevertheless, issues with misinformation and dependability continue to persist. The findings also underlined the expanding importance of Artificial Intelligence (AI) in journalism education, especially in the verification and review of visual information. AI-powered solutions facilitate picture authentication and assist learners in critically assessing digital content. In conclusion, UGI has become a crucial component of modern news creation, helping to enhance critical evaluation abilities. The research underlined the significance of maintaining professional standards, using AI-supported verification tools and adhering to ethical principles to guarantee responsible usage of visual content. These indicators further contribute to information credibility, enhanced public confidence and facilitation of informed judgement in professional photojournalism.

Keywords: Digital Media, Media Ethics, Photojournalism, User-Generated Imagery (UGI)

Introduction

There have been fundamental changes in the production, distribution, and consumption of audio-visual content in the field of journalism because of the development of digital media and social platforms. Due to this change, the media landscape is now more decentralised, with multimedia content dominating in terms of audience engagement. User-generated imagery (UGI) has become more popular because of this participatory culture (Peña-Fernández et al., 2024). In modern days, the integration of UGI in newsrooms has emerged due to the popularity of social media platforms in the digital

media. Visual and textual content of current news events on social media platforms has increased in size and breadth. This is due to the huge availability of smartphones with high-quality cameras and internet access. News organisations can collect breaking news stories and trending updates at a rapid speed due to the published content on social media (Khan et al., 2023).

Modern educational frameworks of journalism are using AI-assisted technologies to handle the huge amount of information. Algorithms, which use machine learning, help to filter the information to determine the reliable sources and identify the fake images. Educational institutions are using AI-assisted technologies for digital storytelling and content verification to help students make the transition from classroom theory to real-world practice. As a result, they will be better equipped to handle media ecosystems and will be more likely to engage in responsible media consumption and creation (Rajalakshmi et al., 2024). The speed at which images circulate across digital platforms has increased, allowing visual content to spread globally in seconds and changing the news consumption methods. The mass sharing of unverified content has also raised the potential for misinformation, raising questions about modern journalism's accuracy and credibility. As journalists and users must evaluate the consequences of providing sensitive or false visual information, these advancements have increased the importance of ethical responsibility. As professional journalism continues to distinguish itself by truth, clarity, and adherence to established conventions despite the rise of UGI, sustaining visual quality standards has become increasingly crucial (Qu et al., 2025). As a result of this integration, media literacy is enhanced, and aspiring journalists are more equipped to use digital media platforms responsibly while maintaining a steady pace of reporting.

Review of Related Literature

UGI has garnered significant interest as a subject of research due to its comprehensive impact on society, media and communication. UGI is a source of unfiltered, on-the-ground information used in news reporting, including pictures, videos and direct feedback from people who were present at events. In war areas or during breaking news, when professional reporters have restricted access, this information can be extremely valuable. Moreover, the study demonstrated that UGI often uses audio-visual communication that strikes an emotional connection with viewers, boosting its capacity to shape beliefs, attitudes, and actions (Breve et al., 2024). In this context, Rahman et al. (2024) emphasised that the ability to effectively document real-time events has been improved by devices that are equipped with computational imaging capabilities and high-dynamic-range capture (HDR). In addition to empowering journalists, this transition also raises ethical concerns about the integration of UGI into mainstream narratives, as the integration of citizen journalism continues to increase (Rahman et al., 2024). On the other hand, Schulte et al. (2022) claimed that professional photographers are able to more accurately craft visual stories by having complete manual control over camera settings. This entails the deliberate selection of shutter speed, depth of focus and exposure to effectively convey expression, mood or action (Schulte et al., 2022). However, in this ever-changing scenario, professional photographers are compelled to redefine their roles and workflows to respond to the rapid growth of UGI. Proficiency in digital storytelling and audience engagement within a dynamic media environment is essential for adjusting to this new landscape, in addition to maintaining technical skills (Kumar, 2023).

Aside from the growing volume of UGI that is shared online on a daily basis, it is becoming simpler to create fake and misleading content using user-friendly and

inexpensive photo editing software. The existence of these technological advancements at the fingertips of every individual presents further difficulties for media practitioners and newsrooms in verifying visual UGI. This is responsible for creating serious ethical issues since photos could potentially be shared without enough context, permission or verification (Ismail et al., 2025). According to research on UGI visual standards, computational improvements such as AI-driven smoothing and HDR blending might increase aesthetics but may unintentionally change a scene's factual depiction. Such improvements have the potential to weaken the visual narrative's considered neutrality and authenticity in journalism, which might result in public distrust or charges of disinformation. Additionally, participatory journalism in China has used social media platforms to transfer authoritative responsibilities from media institutions to users, emphasising the democratic empowerment potential of UGI (Zasiekin et al., 2022). Moreover, another study by Chunqiong et al. (2025) discovered that those whose cultures value certainty with greater respect (like Japan and China) are less likely to accept unverified information as well as more inclined to seek more regulation from regulatory bodies. Hence, the comprehension of cultural dynamics is crucial for understanding different attitudes towards platform responsibility (Chunqiong et al., 2025).

The consideration of authenticity and deceptive knowledge leads to the implementation of AI techniques, which are essential for assessing UGI in professional journalism. These strategies investigate irregularities that might determine manipulation, pixel configurations, or compression artefacts. Big data technological approaches also allow for the correspondence of content from extensive databases to determine representatives of image duplication, replication, or distortion (Tran et al., 2022). Another element of AI-driven validation is the employment of digital provenance tracking and metadata analysis that assist in determining the origin and evolution of visual content. These instruments are also being combined with educational settings, where students are taught to essentially assess digitalised content, determine inaccurate information and comprehend verification approaches. When negotiating with digital media content, students are instructed to consider visual dependability, understand context, and exercise honourable judgement (Zhang et al., 2024).

Participatory Culture Theory by Jenkins (2006) examined how digital technologies have made viewers active media producers and distributors. The theory stated that individuals create, share, and combine material online. This highlighted aspects such as low participation barriers, focused creative and sharing assistance, and informal user mentorship. The theory explained the ways digital surroundings influence communication and how information is generated, transmitted, and understood in modern society (Jenkins, 2006). According to Sujatmiko et al. (2025), Participatory Culture Theory may assist in detecting UGI's growing influence on professional photography. People actively engage in news generation by producing and sharing visual content. This might impact visual narratives and journalistic standards. Professionals alone no longer develop content, affecting visual standards and media ethics. UGI transforms news narratives, redefines trustworthiness and influences audience-driven visual culture in journalism (Sujatmiko et al., 2025). Thus, the theory supported this study by explaining the role of audience involvement and the production of digital media in journalistic credibility and ethical limits in modern photography.

Objectives

- To examine the influence of user-generated imagery on professional photojournalism.

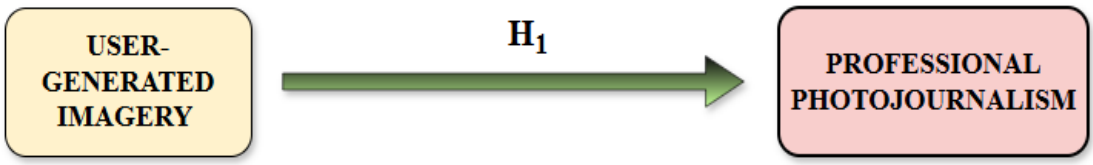
Methodology

Research Design and Procedure

The purpose of this research was to investigate the effect of UGI on professional photojournalists. The study used mixed-method, cross-sectional design that incorporated quantitative and qualitative techniques. This study used a quantitative approach to collect numerical data from professional photojournalists of Chinese media organisations. The objective was to identify the relationship between research variables and their factors. For data collection purposes, the researcher distributed a structured questionnaire to the survey participants. The study used a pilot test for validity assessment and Cronbach's Alpha for reliability assessment. The researcher used SPSS 25 to perform statistical analysis for the data. The 95% confidence intervals helped the researcher to identify the strength and direction of the statistical relationship. The study established the statistical significance at $P < 0.05$. Moreover, the researcher conducted descriptive analysis to identify the key characteristics of the data and Analysis of Variance (ANOVA) to examine the relationship between the research variables.

In addition to the quantitative design, the qualitative method helped the researcher to understand the experience, perspectives and interpretations of respondents to examine the role of UGI in modern journalism. The researcher used semi-structured interviews to gather data from the participants. Moreover, thematic analysis was used to develop the critical awareness of the research subject. The researcher selected Chinese media organisations to choose participants who have practical knowledge in photojournalism. Furthermore, interviews were transcribed for systematic study. As a result, the gathered data was categorised according to recurring themes about the value of UGI and its influence on professional photography. In this context, the research established qualitative reliability through credibility, transferability, confirmability, and dependability. The researcher ensured credibility by accurately reflecting photojournalists' perspectives on UGI. Transferability was addressed by examining whether the findings can be useful in other situations, particularly in similar media environments. Confirmability was ensured by maintaining an audit trail and documentation of data collection and theme development. Dependability was achieved through consistent coding and systematic thematic analysis across all interview responses of professional photojournalists.

Operational Framework



Subjects or Data Sources

The study used structured questionnaires and in-person interviews to collect the data to analyse. Professional photojournalists from different Chinese media organisations were

selected as samples for the study. The survey had two distinct sections: the first part included questions about the demographics of the participants and a structured questionnaire based on a 5-point Likert scale. Additionally, the researcher conducted structured and open-ended interviews to gather primary data. This allowed for a deeper understanding of the research variables with the help of qualitative thematic analysis.

Instrumentation and Data Analysis

The study used a convenience sampling method to choose relevant participants for the study. RaoSoft suggested a total of 461 samples for adequate data collection from the targeted population. Therefore, the researcher distributed 575 survey questionnaires to the selected Chinese professional photojournalists. A total of 532 individuals filled out the surveys and submitted them to the researcher. The researcher discarded 32 questionnaires because they were incomplete. Therefore, the final sample size for the study was 500. Both SPSS 25 and MS-Excel were implemented to evaluate quantitative data. With the objective to understand the fundamental characteristics of the data, the researcher implemented descriptive analysis, while ANOVA was implemented to analyse the collected data.

The qualitative data were gathered via semi-structured interviews from 113 selected participants. Further, the researcher used thematic analysis to evaluate the gathered data. In this procedure, underlying patterns were used to classify the data from the collected interviews. Further, the researcher used an inductive coding strategy to organise the data into themes. This helped in extracting generalisable information about the study context from the interviewees' experiences and expertise with the help of simplified representations of the data.

Limitations

Several limitations in the mixed-method research strategy might have impacted the results. Due to the increasing complexity of the research process, the combination of qualitative and quantitative methodologies required considerable time and resources for data collecting, analysis and interpretation. Challenges in balancing different interpretations and maintaining consistency across data types developed as a result of integrating qualitative and quantitative findings. Due to the possibility of participants providing socially desirable answers instead of completely accurate responses, response bias might have been incorporated into the data set by interviews and surveys. Additionally, researchers' inherent biases and subjectivity might have influenced the interpretation of qualitative results. Additional limitations in establishing long-term changes or causal connections were introduced by the study's cross-sectional design.

Analysis

Quantitative Analysis

- **Factor Analysis**

  Factor Analysis (FA) is used to identify the hidden elements in observable data. By looking for connections between variables, this strategy seeks to find discrepancies, trends or inconsistencies in the information. In this context, the KMO test is used to measure sampling adequacy for FA. If the data is factorable and the theoretical model is predictive, then the KMO value is an accurate measure of that. Another advantage is the ability to detect possible cases of variable duplication or redundancy. In addition, factor analysis makes the data

easier to grasp by clustering variables that are related. The range of potential values for the KMO statistic ranges from 0 to 1.

If the KMO value is between 0.8 and 1, it suggests the sampling was sufficient. According to Kaiser, there are different ranges of acceptable limits for approval: poor (between 0.50 and 0.59), below average (between 0.60 and 0.69), medium (between 0.70 and 0.79), satisfactory (between 0.80 and 0.89), and excellent (between 0.90 and 1.00).

Table 1: KMO and Bartlett's Test
Testing for KMO and Bartlett's Sampling Adequacy Measured by Kaiser-Meyer-Olkin: 0.926
The results of Bartlett's test of Sphericity are as follows:
Approx. chi-square= 4158.637
df =190; sig =.000

Table 1: KMO and Bartlett's Test

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.926
Bartlett's Test of Sphericity	**Approx. Chi-Square**	4158.637
	df	190
	Sig.	.000

The broad significance of the correlation matrices was further confirmed using Bartlett's Test of Sphericity. Kaiser-Meyer-Olkin sample adequacy score was 0.926. Using Bartlett's Sphericity test, researchers found a p-value of 0.00. A significant test result from Bartlett's Sphericity test proved that the correlation matrix was not an identity matrix.

Independent Variable

- **User-Generated Imagery (UGI)**
  UGI is any kind of media (photos, videos, text, and reviews) that is created by actual people instead of any brand. App screenshots, gameplay videos, user reviews and social media postings on apps are numerous examples of UGI in the context of mobile apps. These contents are developed by people in an organic way and shared across many digital platforms. It often represents real user experiences and views. There has been a massive increase in UGI due to the widespread availability of connected gadgets and interactive platforms. The foundation of several well-known service-oriented websites of the modern period is UGI. The function of UGI is specific within the framework of online journalism, despite its widespread usage across all digital media platforms. Journalists use UGI to increase, educate, and sometimes even build upon their own work. In addition, viewers may participate in reporting and sharing stories by adding their own voices to the equation (Qu et al., 2025).

Dependent Variable

- **Professional Photojournalism**

  The practice of using images to convey a narrative is known as photojournalism. Unlike traditional journalists, photojournalists capture their subjects' surroundings via the lens of a camera. If executed effectively, a reader is unlikely to require words to completely comprehend the information sent by a photojournalist. Professional photojournalism adheres to several moral values such as respect for privacy, subject sensitivity and accountability in reporting events. It is the duty of photographers to think about the impact of their captured photos on people and communities. They need to check facts and make sure that their pictures are not misleading the audience (Li & Bang, 2026). In general, the dedicated visual documentation of current events provided by professional photography is crucial in moulding public awareness. It is the duty of photojournalists to properly comprehend events via the photos they capture. They maintain the standards of journalism by basing their decisions on moral and ethical principles. This is essential for them to provide truthful and objective depictions of events (Khan et al., 2023).

- **Relationship between UGI and Professional Photojournalism**

  Professional photojournalism and UGI have different norms and functions, yet they are both crucial in media environment of modern days. Reputable journalists follow strict ethical guidelines, utilise original sources to verify all claims and deliver their narratives using present narrative points. On the other hand, UGI highlights the current and personal perspectives, offering raw, unadulterated perspectives on events. UGI is becoming increasingly significant in the contemporary media landscape. The fact that UGI includes real consumers supporting products or services contributes to its legitimacy and dependability. Nevertheless, the relationship between UGI and professional photography is evolving more significantly due to this intersection. In fast-paced or challenging circumstances, news agencies are relying increasingly on UGI to supplement human reporters. In contrast to professional photography, the absence of editorial supervision in UGI increases concerns about the possibility of misinformation and misunderstanding. Lack of training among content makers also gives rise to ethical concerns, including privacy breaches and unauthorised content sharing. Consequently, professional photography must change by embracing UGI and strengthening verification criteria, which guarantee media credibility and responsibility (Ismail et al., 2025).

  Following up on the previous discussion, the hypothesis was established to examine the important relationship between professional photojournalism and UGI:

  - ***"H_{01}: There is no significant relationship between user-generated imagery and professional photojournalism."***
  - ***"H_1: There is a significant relationship between user-generated imagery and professional photojournalism."***

Table 2: H_1 ANOVA Test

ANOVA					
Sum					
	Sum of Squares	**df**	**Mean Square**	**F**	**Sig.**
Between Groups	36521.358	127	2857.687	1016.247	.000
Within Groups	998.983	372	2.812		
Total	37520.341	499			

The study produced noteworthy results. An F-value of 1016.247 and a p-value < 0.05 showed the statistical significance. This denoted that the researcher rejected the null hypothesis and accepted the alternative hypothesis, "H1: There is a significant relationship between user-generated imagery and professional photojournalism".

The results demonstrated a noteworthy and important connection between UGI and professional photojournalism with the help of a significant p-value and high F-value. This showed that UGI could be considered a crucial part of journalistic practices in the current era. However, the integration of UGI additionally creates issues regarding ethics and credibility. This demands the immediate implementation of professional regulations and maintenance of media dependability and verification standards.

Qualitative Analysis

Qualitative research analyses intentions, perceptions, experiences, and social relations. It strives to comprehend the explanation of the way people believe, function, and react in exceptional conditions rather than depending upon numerical data. Interviews, observations, and open-ended reactions generally gather data. This shows practices, compositions, and interpretations. This approach functions sufficiently for examining complicated, developing problems that possess human viewpoints.

In examining the effect of UGI on professional photojournalism, the qualitative technique helped understand the way journalists, consumers, and content suppliers interact with visual content. The researcher focused on journalistic media ethics and visual culture trends. Through experiences and opinions, the qualitative study revealed how UGI affects media credibility, decision-making, and professional standards.

Interview Questions (Open-ended)

Questions
1) What impact has user-generated imagery had on the duties of a photojournalist within an organisation?
2) How does the rapid spread of user-generated imagery influence the everyday operations and editing choices?
3) What methods do professional photojournalists use to assess the credibility and validity of user-generated photos, especially under time restrictions?

4) What changes have been noticed in photojournalistic ethics and visual culture as a result of the increasing usage of user-generated imagery?
5) What ethical concerns arise from the integration of user-generated imagery in professional journalism?
6) While using the photographs that were captured by non-professionals, how do photojournalists handle both permission and ownership?
7) Based on work experience, how have user-generated images influenced changes in visual culture and narrative approaches within Chinese media?
8) In what ways do audience expectations and involvement influence the decision of the photojournalists regarding using user-generated imagery in news reporting?
9) In which circumstances have user-generated imagery significantly impacted the reporting approaches of professional photojournalists?
10) What adaptations are expected in professional photography due to the increasing growth of user-generated imagery in Chinese media?

Thematic Coding

Themes	Keywords	Interpretations
Transformation of Professional Photojournalism	Workflow modifications, dependence on UGI, editorial decisions and reduced fieldwork	Reconfigures procedures and the generation of content
Validation and Authenticity in Professional Standards	Verification of authenticity, review of sources, minimal editing, inconsistent quality	Presents difficulties in verifying and maintaining quality standards
Ethical Dilemmas and Obligations	Misinformation, confidentiality, misuse, exploitation of intellectual property, authorisation, and recognition	Raises substantial ethical and legal issues in professional photojournalist approaches
Visual Culture and Audience Psychology	Interactive media, diverse visuals, audience involvement, authenticity	Revolutionises both the visual culture and the expectations of the audience

Theme 1: Transformation of Professional Photojournalism

The growing popularity of UGI has had a profound impact on the transformation of professional photojournalism. With the help of carefully planned editorial procedures and real-life reporting, photojournalists used to be in charge of collecting, editing and presenting visual content. Nevertheless, these traditional methods have changed due to the increasing accessibility of UGI. News organisations now employ images captured by public, especially for significant subjects that need visual coverage. This move has accelerated content creation and reduced the need for field reporting. As photojournalists increasingly assess and include pictures from other sources with their own work, editorial decision-making has also changed. These needs adopting quick content selection and dissemination strategies. Journalists now compile and assess visual content from external sources in addition to producing it. Additionally, by combining other viewpoints that

would not have been available via traditional methods, the inclusion of UGI expanded the breadth of visual storytelling. Thus, this transformation enabled the massive transformation of professional photojournalism with the help of UGI.

Theme 2: Validation and Authenticity in Professional Standards

With the growing usage of UGI, validation and authenticity remain crucial to preserving professional standards in photography. Discovering the origin, context and correctness of visual information is a challenge with UGI, in contrast with traditional photojournalism that relies on photos captured by trained specialists. Consequently, photojournalists must implement stricter verification techniques to guarantee that published photos maintain professional standards and ethical norms. Validation involves evaluating sources, comparing data, and using digital technologies such as AI-based tools to verify information, location, and time. Due to the fast spread of UGI, there is a conflict between quick action and reliable findings. There is a possibility that this may lead to issues with dependability and consistency in quality. A further issue that impacts professional standards is the wide range of technical quality among UGI. Certain images convey information in real time, while others may be misleading or poorly developed. Therefore, photojournalists must be careful while including such content in narratives. Hence, it is evident that validation and authenticity have been the main concerns of UGI in the domain of professional journalism.

Theme 3: Ethical Dilemmas and Obligations

The ethical dilemmas and obligations of journalists have grown as a consequence of the inclusion of UGI into professional photojournalism. UGI, developed without journalistic constraints, raises concerns about truth, authorisation, innovation, and ethics. Photojournalists should thoroughly check such information for media ethics before publishing. As misinformation and exploitation are serious ethical risks. People face the risk of misleading others when they edit, remove context or misinterpret their captured photos. Therefore, experts must validate the photographs and shooting locations. Sharing photos without authorisation may potentially breach privacy in sensitive circumstances like accidents or disputes. There are further difficulties related to ownership and intellectual property rights. When information comes from people who are not professionals in the field, it can be difficult to determine who owns the rights to an image and make certain that it has been credited correctly. Legal consequences and negative effects on media integrity can arise from neglecting these concerns. Therefore, ethical dilemmas and obligations regarding usage of UGI influence professional photojournalism in an extensive way.

Theme 4: Visual Culture and Audience Psychology

UGI has caused a significant transformation in professional photojournalism's visual culture and audience psychology. Due to the widespread availability of images taken by ordinary citizens, the news media have received more innovative, diverse and emotionally compelling pictures. The audience is now preferring reliability and authenticity of the visual content over technological excellence. This indicates the shift in development and use of journalistic content. As a result of this transformation, audiences are no longer considered passive consumers but rather active participants in the visual storytelling process. UGI's casual and unedited manner shapes viewers' reactions to and knowledge of current events, frequently elevating emotional connection. At the same time, the trust of the audience continues to be negotiated, as an excessive amount of visual content creates uncertainties about the trustworthiness of the content. Overall, the UGI is altering

visual culture by influencing the personal preferences of audiences, patterns of engagement, and the psychological impact of photojournalistic imagery.

Qualitative Thematic Findings

The thematic analysis revealed that UGI has altered professional photojournalism in terms of ethics and visual culture. In the first theme, there is an emphasis placed on a significant difference in professional practice. It is no longer sufficient for photojournalists to depend only on field reports. They use a substantial number of photographs that were captured by various other individuals. As a result of this transformation, their responsibilities shift from that of production to those of collector and critic. In the second theme, the focus is on the validity and legitimacy of professional standards. In light of the data, it was clear that verification continues to become ever more difficult and demanding. Journalists verify the accuracy of their sources with AI-powered tools and check the context before utilising photographs in their reporting activities. Redefining professional standards is being done as a reaction to the growing prevalence of UGI. The third theme simplifies the understanding of fundamental ethical dilemmas and obligations. Regarding ownership, privacy, and the broadcast of misleading information, the use of UGI presents significant challenges. It is the duty of journalists to ensure that photos are used in a responsible manner, without causing any damage to the individuals shown in the photographs or distorting them in any way. Therefore, ethical responsibility plays a more important part in the process of decision-making as a consequence of this reality. The focus of the fourth theme is on the developments that have taken place in the fields of audience psychology and visual culture. Audiences are more likely to engage with content that seems to be authentic and is given in a timely manner. This leads to a change in visual culture, making it participatory, in which viewers consume media content and also contribute to it. Overall, the findings suggested that UGI continues to have an impact on the professional methods, ethical standards and audience engagement that are connected with modern photojournalism.

Findings and Discussion

The quantitative results indicated an effective and statistically noteworthy relationship between UGI and professional photojournalism. With a KMO score of 0.926, the sample adequacy was excellent, suggesting that the data were eligible for factor analysis. Moreover, the variables were sufficiently related for analysis, as shown by the significant results of Bartlett's Test of Sphericity ($p < 0.05$). An extremely high F-value of 1016.247 with a significance level below 0.05 was achieved by the ANOVA, further supporting this association in the hypothesis testing findings. The researchers accepted the alternative hypothesis and rejected the null hypothesis. According to these results, professional photojournalism is significantly impacted by UGI. Its importance in modern journalism has grown to the point that it is no longer a secondary consideration. Public contributions are becoming more integrated into professional processes, which is reflected in the growing dependence on UGI.

The qualitative findings corroborated and extended these results by explaining the mechanisms of this influence within the domain of newsroom practices, ethics and visual culture. The themes explained that professional photojournalism has changed massively, from field reporting to content creation by individuals. As journalists are now required to establish the authenticity within a very short period, the role of verification methods has been enhanced. This leads to better identification of privacy and ownership, which is considered the responsibility of the modern photojournalist. These findings revealed that

apart from promoting diversity and audience engagement, UGI also develops problems regarding standard maintenance and public trust.

The findings of this research provided a broader perspective of the influence of UGI on professional photojournalism by showing both convergence and distinction between the quantitative and qualitative findings. The quantitative findings revealed a strong and statistically significant link between UGI and professional photojournalism, as demonstrated by significant hypothesis testing results. This suggested that UGI has evolved into a structurally incorporated component of contemporary journalism, rather than a supplemental instrument. This was supported by qualitative findings that showed how UGI actively influenced photojournalists' duties and responsibilities. Professionals are no longer limited to traditional field reporting; they are increasingly involved in choosing, validating and incorporating externally created photos into news content. This combined data demonstrated an obvious change in journalistic practice, with content creation becoming a more dynamic and collaborative process, including both professionals and the public. Simultaneously, the comparison of results demonstrated that UGI has an impact on professional standards and media ethics in addition to practice. While the quantitative research revealed the importance of UGI, the qualitative results revealed the way this effect is responsible for verification procedures and ethical decision-making. The rising dependence on UGI has highlighted the significance of AI-based authenticity verification and source assessment, since journalists must guarantee that visual content is correct and dependable. Moreover, misinformation and ownership have gained importance, which indicates the need for stricter criteria and responsible actions among the professionals. Both analyses demonstrated that these transformations have been transformed by the expectations of the audience. However, the integration of UGI requires constant changes in adaptation to find a balance between the advantages and drawbacks to secure the credibility and accuracy of the data. It enhances the public confidence in a media landscape that is always exploring innovative ideas.

Conclusion

The research concluded that professional photojournalism has been greatly impacted by UGI in terms of practice, media ethics, and visual culture. The results demonstrated that UGI might enhance availability of real-time visual information and expand the range of viewpoints in news reporting when appropriately controlled. This indicates that UGI is a significant part of modern media rather than a supporting component. Important elements like editorial judgement, adherence to ethical norms, and verification processes determine its integration into the professional media. UGI provides significant advantages, such as accelerated content accessibility and enhanced audience interaction. Nonetheless, it also increases inconsistent results in quality and dependability owing to the lack of expert supervision throughout content generation. These disparities can undermine the trust of visual reporting, especially in contexts where accuracy is fundamental. Despite this concern, the research showed that organised verification processes, detailed editorial guidelines and careful application of AI tools could minimise these shortcomings. The research underscored its capacity to enhance visual storytelling while also highlighting the need for constant evaluation and improvement. Future initiatives must prioritise the enhancement of consistency, the refinement of AI-based verification tools for future journalists and the analysis of long-term consequences to facilitate their ethical use in dynamic media landscapes.

The research findings have significant implications for professionals in media organisations, teachers and policy makers. The research indicated that stringent validation and ethical assistance are essential to incorporate UGI. This assists in confirming the credibility and dependability of photojournalism. This may enhance the precision of the information and the overall quality of the visual journalism. It may also highlight that UGI may be used to boost audience participation and change journalistic descriptions. Policymakers may employ these outcomes to construct stringent guidelines, which will manage misinformation, security and ownership. Further, the employment of AI in the academic sector may improve the rate of digital literacy of future journalists by increasing their validation capacities and skills of critical thinking.

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How Generative AI Reshapes Classroom Dialogue in Chinese Higher Education: A Mixed-Method Study of AI-Enhanced Dialogic Teaching

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Abstract

This study investigates how generative artificial intelligence (GenAI) reshapes classroom dialogue in Chinese higher education through a mixed-method design grounded in dialogic teaching theory. Moving beyond prior research that emphasizes AI adoption and user perceptions, this study conceptualizes GenAI as a structural mediator of classroom dialogue that influences instructional design, interaction processes, and student engagement. Data were collected from two Chinese universities, including 12 undergraduate courses, 10 teacher interviews, 24 classroom observations, and 221 student questionnaires. Quantitative results show significant increases in classroom participation (+22.2%), contribution frequency ($p < .001$), and higher-order cognitive responses, while overall learning engagement remains relatively stable. Qualitative findings reveal four interrelated mechanisms through which GenAI supports dialogic teaching: AI-assisted lesson design, AI-supported questioning sequences, AI-driven personalized learning support, and AI-facilitated collaboration. These mechanisms correspond to and extend Alexander's principles of dialogic teaching by enhancing purposefulness, reciprocity, supportiveness, cumulativeness, and collectively. The study proposes a GenAI-Enhanced Classroom Dialogue Framework, demonstrating that GenAI does not directly affect learning outcomes but reshapes them through restructuring classroom dialogue. The findings suggest that GenAI primarily enhances teachers' pedagogical design capacity and enables more structured, inclusive, and cognitively demanding classroom interaction.

Keywords: Classroom Interaction, Dialogic Teaching, Generative AI, GenAI, Higher Education Teaching

Introduction

Tahfiz Generative Artificial Intelligence (GenAI), represented by large language models such as ChatGPT, is rapidly reshaping teaching and learning practices in higher education. In contrast to traditional educational AI, which has primarily focused on grading, recommendation systems, and learning analytics, GenAI is characterized by its natural language generation and context-aware interaction capabilities, enabling it to directly participate in curriculum design, classroom interaction, and learning support processes (Kasneci et al., 2023; Tlili et al., 2023). UNESCO (2023) and the OECD (2019)

both highlight that GenAI is transforming knowledge production and reshaping teacher roles as well as the organizational logic of teaching.

Against the backdrop of China's ongoing internationalization of higher education and the national strategy for educational digitalization, the application of GenAI in university teaching has been expanding rapidly. In recent years, Chinese universities have actively explored the use of generative AI tools such as ChatGPT, ERNIE Bot (Wenxin Yiyan), Tongyi Qianwen, and iFlytek Spark in teaching practices, gradually integrating them into curriculum design, learning support, and instructional management (Li & Wang, 2024). From curriculum resource development to personalized learning support, and from structuring classroom discussions to guiding collaborative projects, GenAI is increasingly becoming an important instructional aid for teachers (Cotton et al., 2023).

Review of Related Literature

Existing research on GenAI in higher education mainly falls into several strands. The first strand focuses on teachers' and students' acceptance of GenAI, their behavioural intentions, and influencing factors, often grounded in the Technology Acceptance Model (TAM) or the Unified Theory of Acceptance and Use of Technology (UTAUT) (Chiu, 2023; Sallam, 2023). The second strand examines the cultivation of AI literacy, exploring how teachers and students understand, evaluate, and use AI technologies (Long & Magerko, 2020; Ng et al., 2021). The third strand concentrates on ethical risks posed by generative AI, including academic integrity, data privacy, algorithmic bias, and students' overreliance on AI (Dwivedi et al., 2023; UNESCO, 2023).

While these studies provide an important foundation for understanding the entry of GenAI into higher education, the existing literature remains largely focused on "AI adoption" and "AI perception," and has not yet fully moved toward examining "how AI reshapes pedagogical processes" (Cui & Teo, 2021). Building on this gap, this study draws on Alexander's (2008) theory of dialogic teaching to explore how GenAI reshapes classroom dialogue mechanisms and influences student participation and learning processes.

Generative AI in Higher Education

The application of artificial intelligence in higher education has evolved from rule-based systems to generative models. Early research primarily focused on intelligent tutoring systems, automated grading, and learning analytics, with the core objective of improving teaching efficiency and providing personalized support (Holmes et al., 2019). With the development of large language models, GenAI has gradually acquired capabilities in content generation, question design, and feedback generation, shifting from an assistive tool to a collaborative participant in the teaching process (Kasneci et al., 2023).

Existing studies indicate that GenAI can support curriculum design, formative assessment, and the generation of learning resources, while also providing students with immediate feedback and support for self-directed learning (Cotton et al., 2023; Lo, 2023). At the same time, research has highlighted ethical concerns such as academic integrity, bias, and risks of overreliance (Dwivedi et al., 2023; UNESCO, 2023). From the perspective of teacher development, GenAI is reshaping the structure of teaching competencies, particularly in areas such as prompt engineering, AI-based evaluation, and ethical judgment (Benyahia, 2025). Overall, the literature in this area remains largely

focused on the functional dimension of "AI as a tool," with limited attention to its structural impact on classroom interaction processes.

Dialogic Teaching and Classroom Dialogue

Dialogic teaching theory, proposed by Alexander (2008), emphasizes that knowledge is co-constructed through sustained interaction. Classroom dialogue is not merely an information exchange process but a core mechanism for promoting reasoning, reflection, and meaning-making (Mercer et al., 2019). Alexander identifies five principles of dialogic teaching: collectivity, reciprocity, supportiveness, cumulativeness, and purposefulness.

In recent years, dialogic teaching theory has been further extended from primary and secondary education to higher education contexts. Research shows that high-quality classroom dialogue can promote students' critical thinking, metacognitive abilities, and deeper disciplinary understanding (Mercer et al., 2019; Asterhan et al., 2015). From a sociocultural theory perspective, classroom dialogue is not only a medium for knowledge transmission but also a key mechanism through which learners co-construct meaning and develop cognitive capacities (Vrikki et al., 2019).

With the development of online learning platforms, collaborative tools, and artificial intelligence technologies, researchers have increasingly examined the impact of digital technologies on classroom dialogue. For example, digital collaborative platforms and intelligent learning environments can expand opportunities for interaction, increase feedback frequency, and support more equitable classroom participation (Firer et al., 2021; Luckin & Cukurova, 2019). The widespread adoption of hybrid learning in the post-pandemic era has further advanced research on technology-supported classroom dialogue. However, discussions on how generative AI intervenes in classroom dialogue mechanisms remain at an early stage.

Towards GenAI-Supported Dialogic Teaching

Recent studies suggest that large language models are inherently dialogic systems, and their generative mechanisms are structurally similar to processes of meaning negotiation in classroom interaction (McMurry, 2025). Therefore, GenAI is increasingly considered a potential cognitive tool for supporting classroom dialogue. Existing research indicates that GenAI can support teaching processes in four main ways: curriculum design optimization, question generation, personalized feedback, and facilitation of collaborative learning (Kohnke et al., 2023). Theoretically, these functions may enhance both the depth and frequency of classroom interaction.

Although emerging studies have begun to explore the impact of GenAI on learning engagement and feedback processes, research on how GenAI specifically supports classroom dialogue, transforms interaction structures, and facilitates knowledge co-construction remains limited (Cui & Teo, 2021). In particular, within Chinese higher education contexts, there is still a lack of systematic empirical evidence on how teachers integrate GenAI into dialogic teaching practices and how such integration shapes student participation and learning processes.

Synthesis and Research Gap

Overall, the existing literature reveals three structural limitations. First, research on GenAI has largely focused on technological adoption and competency development,

treating AI as an external tool rather than a structural variable embedded in pedagogical processes. Second, although dialogic teaching research emphasizes the importance of classroom interaction, it implicitly assumes teacher-centered dialogue design and lacks theoretical engagement with the intervention of external intelligent systems. Third, studies on the educational value of GenAI tend to focus on learning outcomes while overlooking classroom interaction as a key mediating mechanism. As a result, a central question remains insufficiently addressed: how does generative AI systematically reconstruct classroom dialogue structures by influencing instructional design and interaction organization?

Building on this gap, this study reconceptualizes GenAI as a "structural mediator of classroom dialogue," focusing on how it reshapes the generative logic of classroom dialogue, through instructional design, questioning structures, personalized support, and collaborative mechanisms, rather than merely improving teaching efficiency or learning outcomes. This perspective addresses the theoretical disconnect between "AI-teaching process-dialogue mechanism" and provides a new analytical lens for understanding classroom interaction in the age of AI.

This study is grounded in Alexander's (2008) theory of dialogic teaching and integrates existing research on the application of Generative Artificial Intelligence (GenAI) in higher education to construct an initial conceptual framework. The framework is designed to examine how GenAI influences classroom dialogue practices and student learning engagement.

Alexander (2008) argues that dialogic teaching emphasizes knowledge co-construction through high-quality classroom interaction. Its core features include collectivity, reciprocity, supportiveness, cumulativeness, and purposefulness. The theory rejects the notion of learning as one-way knowledge transmission and instead conceptualizes it as a process of meaning-making through sustained teacher–student interaction. Accordingly, the quality of dialogue becomes a key determinant of students' learning engagement and cognitive development.

Building on this theoretical foundation, this study posits that GenAI does not directly influence student learning outcomes. Rather, it first shapes teachers' teaching practices, which in turn affect classroom dialogic processes, and ultimately influence student engagement outcomes. Based on this logic, an initial conceptual framework is developed (Figure 1).

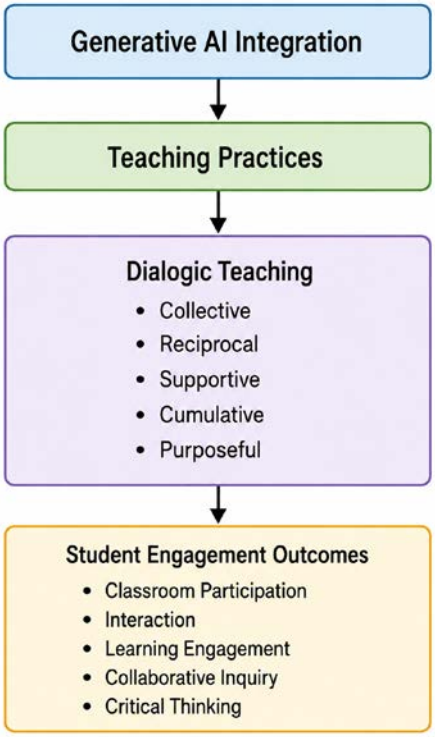

Figure 1. *Initial Conceptual Framework*

Figure 1 presents the initial conceptual framework of this study. It assumes that GenAI indirectly influences classroom dialogue processes by shaping teaching practices, which in turn affect student learning engagement. Specifically, GenAI is conceptualized as a pedagogical enabler that supports teachers in instructional design, classroom interaction organization, and learning support activities. These teaching practices subsequently shape the organization and quality of classroom dialogue, thereby influencing student engagement through dialogic teaching processes.

However, the specific mechanisms through which GenAI affects classroom dialogic practices remain insufficiently evidenced. To address this gap, this study adopts a convergent mixed methods design, combining classroom observations, teacher interviews, and student questionnaires to explore the mechanisms through which GenAI supports dialogic teaching in practice.

Research Questions

Specifically, this study investigates how teachers use GenAI to support instructional design, classroom questioning, personalized learning, and collaborative learning, and addresses the following research questions:

- RQ1: How do teachers use GenAI to implement dialogic teaching?
- RQ2: Through what mechanisms does GenAI influence classroom dialogue and student participation?
- RQ3: What are the opportunities and challenges of its application?

Methodology

Research Design

This study adopts a convergent parallel mixed methods design, in which qualitative and quantitative data are collected simultaneously and integrated during the analysis phase to

achieve a multi-layered interpretation (Creswell & Plano Clark, 2018). Qualitative data are used to uncover the mechanisms through which GenAI operates in classroom dialogue practices, while quantitative data are employed to examine its effects on student participation and learning engagement.

This design is particularly suitable for research at the intersection of educational technology and teaching processes, as it enables both an understanding of the complexity of pedagogical practice and the empirical verification of outcomes (Creswell & Plano Clark, 2018; Tashakkori & Teddlie, 2010). It also facilitates methodological complementarity and triangulation (Poth, 2023), thereby enhancing the explanatory power and rigor of the study.

Research Setes and Participants

This study selects two representative universities in China as research sites: one public university and one private (non-state) university. The inclusion of different institutional types aims to enhance the external validity of the study (Creswell & Poth, 2018) and to compare how generative AI is applied in teaching practices under different institutional contexts and resource conditions (Merriam & Tisdell, 2016; Yin, 2018), as shown in Table 1. Both universities have incorporated GenAI tools into multiple courses to support classroom discussion design, learning feedback, and project-based instruction.

Table 1. Research Context and Participants Overview

Component	**Description**
Research sites	Two higher education institutions in China: one public university and one private university
Course scope	12 undergraduate courses in total, covering business, social sciences, and natural sciences
Student participants	221 undergraduate students with varying levels of academic ability and classroom participation
Teacher participants	10 university teachers integrating GenAI into teaching, with 3–18 years of teaching experience across disciplines (e.g., marketing, education, mathematics)
Sampling strategy	Purposive sampling (selecting courses where GenAI is actively used in classroom practice)
Ethical considerations	All participants signed informed consent forms, and all data were anonymized

Data Collection

To ensure data diversity and complementarity (Creswell & Plano Clark, 2018; Flick, 2023), this study employs three data sources: classroom observation, teacher interviews, and student questionnaires, as summarized in Table 2.

Table 2. Overview of Data Collection Methods

Data type	**Source and scale**	**Key details (duration / method / purpose)**
Qualitative data	Classroom observation (24 sessions across 12 courses)	90–120 minutes per session, totaling approximately 48 hours; records instructional design, questioning strategies, student interaction, group collaboration, and GenAI usage
	Teacher interviews (10 teachers)	Semi-structured interviews, 45–75 minutes each; conducted both online and offline; all audio-recorded and transcribed

		verbatim to analyze teachers' AI pedagogical practices and perceptions
Quantitative data	Student questionnaire (221 students)	Five-point Likert scale; measures classroom participation, learning engagement, and perceived AI support; used for statistical analysis and group comparisons
Research design integration	Convergent parallel mixed methods design	Qualitative and quantitative data collected simultaneously; integrated through triangulation for comprehensive analysis and interpretation

Analysis

Data Analysis

Qualitative analysis follows Braun and Clarke's (2006) thematic analysis approach, including familiarization with data, initial coding, theme generation, and theme review. Coding focuses on four categories of AI-supported teaching practices: curriculum design support, questioning structure optimization, personalized learning support, and collaborative learning facilitation. The resulting themes are then mapped onto Alexander's (2008) five principles of dialogic teaching to achieve theoretical integration.

Quantitative analysis combines descriptive and inferential statistical methods. Specifically, mean comparisons and paired-samples t-tests are conducted. The key indicators include classroom participation rate, interaction frequency, and learning engagement scores. The significance level is set at $p < .05$ to test changes in these indicators before and after the introduction of GenAI (Field, 2018).

Findings and Discussion

Based on classroom observations, teacher interviews, and student questionnaire data, this study analyzes teaching practices and learning outcomes of GenAI-supported dialogic classroom interaction. The findings are presented in two parts: quantitative findings and qualitative findings.

Quantitative Findings

This study adopts a within-subject pre-post design to examine changes in learning behaviors and learning engagement among 221 students before and after the introduction of GenAI-supported classroom dialogue. Data analysis includes descriptive statistics and paired-samples t-tests, with the significance level set at $p < .05$.

Descriptive Statistics Results

Table 3 presents the descriptive statistical results of changes in classroom participation behaviors and learning engagement among 221 students before and after the introduction of GenAI. Overall, most behavioral indicators show an upward trend in the post-test stage, while changes in learning engagement are relatively small.

Table 3. Student Classroom Participation and Learning Engagement (n = 221)

Indicator	**Pre-test (M)**	**Post-test (M)**	**SD (Pre/Post)**	**Change**
Classroom participation rate (%)	56.2	78.4	14.6 / 18.3	+22.2
Number of classroom contributions (times/class)	3.1	5.2	1.8 / 2.7	+2.1
Student speaking confidence (1–5)	3.4	3.9	0.74 / 0.81	+0.5

Learning engagement score (1–5)	3.52	3.47	0.68 / 0.79	−0.05

Paired-Samples t-Test Results

Table 4 reports the results of the paired-samples t-tests. The findings show that both classroom participation rate and number of contributions reach statistical significance ($p < .001$). Speaking confidence shows a small but significant increase, while learning engagement does not reach statistical significance ($p = .063$).

Table 4. Differences in Student Performance under Different Classroom Conditions

Variable	t-value	df	p-value	Cohen's d	Direction
Classroom participation rate	7.18	220	< .001	0.63	Significant increase
Number of contributions	6.02	220	< .001	0.51	Significant increase
Speaking confidence	4.11	220	< .001	0.29	Slight increase
Learning engagement	-1.87	220	.063	0.13	Non-significant decreasing trend

Observational Behavioral Data

Table 5 presents changes in classroom behavioral observation data. The results show that total student contributions increased from 214 to 356. The proportion of teacher-led talk decreased from 71% to 58%, while student-led interaction increased from 29% to 42%. The proportion of higher-order cognitive responses increased from 31% to 46%.

Table 5. Changes in Classroom Interaction Behaviors (Observation Data)

Behavioral indicator	Early stage	Later stage	Change
Total student contributions	214	356	+142
Teacher-led talk (%)	71%	58%	−13%
Student-led interaction (%)	29%	42%	+13%
Higher-order cognitive responses (%)	31%	46%	+15%

Polarization in Learning Engagement

In the dimension of learning engagement, further subgroup analysis reveals clear differences. Table 6 shows changes in engagement among students with different participation levels. The results indicate that high- and low-participation students show slight increases, while medium-participation students show a decline.

Table 6. Changes in Learning Engagement by Group (Polarization Effect)

Student type	Pre-test	Post-test	Change
High-participation students (Top 30%)	4.01	4.18	+0.17
Medium-participation students (Middle 40%)	3.52	3.41	−0.11
Low-participation students (Bottom 30%)	2.91	3.05	+0.14

Summary of Quantitative Results

Based on paired-samples t-tests and classroom behavioral statistics, student classroom participation significantly increased in the post-test stage ($p < .001$), and the proportion of higher-order cognitive responses also rose. However, learning engagement did not show statistically significant change ($p = .063$) and exhibited heterogeneous patterns across different student groups.

Qualitative Findings

Theme 1: AI-Assisted Lesson Planning

This theme addresses Research Question RQ1, focusing on how teachers use generative AI to design lessons in ways that enhance the purposefulness of classroom dialogue.

The findings show that teachers commonly use GenAI as a "cognitive external brain" in the early stage of instructional design. It is used to generate teaching cases, design discussion topics, anticipate possible student responses, and construct the structure of classroom activities. This process significantly strengthens the goal orientation and structuring of classroom discussions. One teacher noted in the interview:
"*In the past, designing discussion questions took a lot of time because I had to imagine how students might respond. Now I can use AI to simulate students' thinking first and then refine my questions accordingly."*

Classroom observations also indicate that in courses where AI-assisted design is used, teachers' questions tend to be more layered, and classroom discussions are less focused on factual recall and more oriented toward explanation and evaluation. From the perspective of Alexander's (2008) dialogic teaching theory, this mechanism primarily strengthens the principle of "Purposeful," shifting classroom dialogue from spontaneous interaction to a goal-directed learning process.

Specific manifestations include:

- Teaching cases are more closely aligned with real-world contexts
- Discussion questions are more open-ended and challenging
- Student discussions are more aligned with learning objectives
- Teachers are able to anticipate and guide discussion trajectories

Therefore, the role of GenAI in the lesson planning stage essentially lies in enhancing the structural organization and cognitive depth of classroom dialogue.

Theme 2: AI-Supported Questioning

This theme addresses RQ1 and RQ2, focusing on how GenAI reshapes classroom questioning structures and thereby promotes student participation and deeper dialogue. The findings show that teachers extensively use GenAI to generate three types of key questions:

- Open-ended questions
- Probing questions
- Higher-order cognitive questions

These questions are typically organized in the form of "questioning sequences," which create a progressively layered structure in classroom discussion. Based on this, the study proposes an AI-supported dialogic questioning sequence model (Figure 2).

Knowledge → Understanding → Application → Evaluation → Reflection

Figure 2. AI-Supported Dialogic Questioning Sequence Model

This model illustrates how teachers use GenAI to generate progressive questioning sequences. Classroom observations show that teachers typically begin with factual questions to activate prior knowledge (Knowledge), then guide students to explain concepts (Understanding), apply knowledge to solve problems (Application), evaluate

different perspectives (Evaluation), and finally engage in reflection and metacognitive discussion (Reflection).

This progression supports a shift in classroom dialogue from information exchange to knowledge co-construction, and strengthens the principles of Reciprocity and Cumulativeness emphasized by Alexander (2008). Classroom observation data further show that in AI-supported questioning classrooms, discussion is no longer a "single-turn Q&A" process but evolves into a continuous knowledge-building trajectory. One teacher stated:
"AI helps me turn a simple question into a five-level progressive sequence, so students don't finish discussing quickly—they keep going deeper."

From Alexander's theoretical perspective, this mechanism strengthens:

- Reciprocity: students respond more frequently and in more diverse ways
- Cumulativeness: discussion continuously builds on prior contributions

Theme 3: AI-Guided Personalization
This theme addresses RQ2, focusing on how GenAI enhances student engagement and psychological safety through personalized support.

The findings show that teachers use GenAI to generate differentiated learning suggestions, personalized feedback, and learning pathway guidance, thereby making classroom dialogue more supportive. Key manifestations include:

- Providing differentiated explanations for students of different ability levels
- Adjusting classroom tasks based on AI-generated learning suggestions
- Offering real-time feedback and supplementary learning resources
- Reducing students' anxiety about speaking in public discussions

A student wrote in the open-ended questionnaire:
"I used to be afraid to speak in class because I was worried about being wrong. But after the teacher used AI to organize our ideas, I feel more confident expressing my thoughts."

Classroom observations also show that in AI-supported personalized learning environments, low-participation students demonstrate a noticeable increase in speaking frequency. From Alexander's framework, this mechanism strengthens the principle of Supportiveness by creating a safe and inclusive dialogic environment in which students at different levels can participate in knowledge construction. Thus, GenAI does not merely "provide information," but lowers the threshold for participation, thereby improving equity in classroom engagement.

Theme 4: AI-Facilitated Collaboration
This theme addresses RQ1 and examines how GenAI supports classroom collaboration and collective knowledge construction.

The findings show that teachers widely use GenAI to support the following instructional activities:

- Group brainstorming
- Collaborative inquiry tasks
- Project-based learning design

In these activities, GenAI is often used as a "shared cognitive tool," helping students generate initial ideas, structure discussions, or provide informational support. Classroom observations indicate that in AI-supported collaborative classrooms:

- Group discussions are more structured
- Task division is clearer
- Students more frequently reference AI-generated content in discussions
- Discussions are more likely to reach shared conclusions

From Alexander's perspective, this mechanism strengthens the principle of Collectivity, where learning is understood as a social process of group participation. One teacher noted: "*AI makes group discussion no longer a situation of 'having nothing to say,' but gives students a starting point*."

Therefore, GenAI in collaborative learning functions as cognitive scaffolding for collective dialogue, thereby improving the efficiency of group collaboration.

Theme 5: Opportunities and Challenges

This theme addresses RQ3 and systematically examines the potential benefits and practical limitations of GenAI-supported dialogic teaching.

Key Opportunities

The findings suggest that GenAI offers several major advantages in classroom dialogue:

1. **Efficiency improvement**: Teachers can generate teaching materials and discussion questions more quickly, significantly reducing preparation time.
2. **Enhanced inclusiveness**: Low-participation students are more easily engaged in classroom discussion.
3. **Improved accessibility of learning resources**: Students gain more immediate explanations and learning support.

Key Challenges

Despite its positive effects, several challenges were identified:

1. Ethical concerns: Some teachers worry that students may become overly dependent on AI-generated content.
2. Teacher competence gaps: Significant differences exist in teachers' ability to use AI, affecting the consistency of teaching outcomes.
3. Student over-reliance on AI: Some students reduce independent thinking and tend to directly use AI-generated answers.

Theme 7: An Emergent GenAI-Enhanced Classroom Dialogue Framework

This study identifies four core mechanisms through which GenAI supports classroom dialogue:

- AI-assisted curriculum design (Purposeful Dialogue)
- AI-supported questioning structures (Reciprocal & Cumulative Dialogue)
- AI-guided personalized learning (Supportive Dialogue)
- AI-facilitated collaborative learning (Collective Dialogue)

Together, these mechanisms improve the quality of classroom dialogue and student engagement, forming an integrated theoretical model: the GenAI-Enhanced Classroom Dialogue Framework (Figure 3). This model illustrates how generative AI influences

classroom dialogue practices through four pedagogical mechanisms, ultimately promoting student participation and learning engagement.

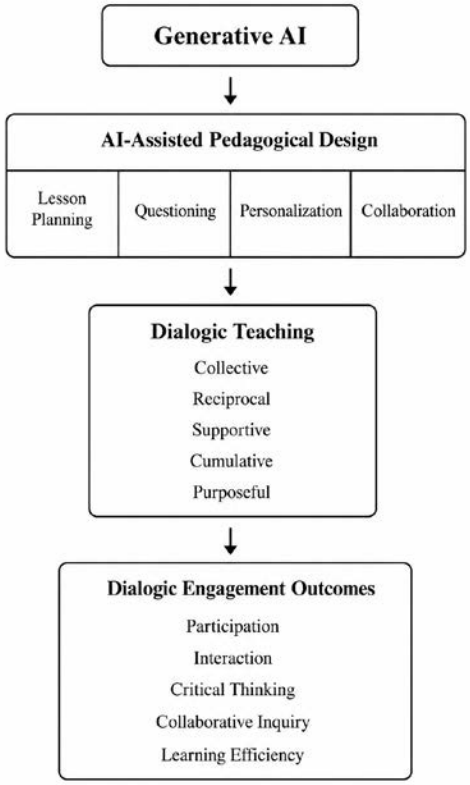

Figure 3. GenAI-Enhanced Classroom Dialogue Framework

This framework indicates that GenAI does not directly influence student learning outcomes. Instead, it first enhances teachers' pedagogical design capacity through AI-assisted instructional design, which in turn activates four key teaching mechanisms: curriculum design, questioning design, personalized support, and collaborative learning.

These mechanisms jointly shape classroom dialogic practices and correspond to Alexander's (2008) five principles of dialogic teaching (Collective, Reciprocal, Supportive, Cumulative, Purposeful). Ultimately, dialogic teaching practices further promote multiple dimensions of student learning outcomes, including participation, interaction, critical thinking, collaborative inquiry, and learning efficiency. Therefore, this study argues that the core value of GenAI in higher education classrooms is not to replace teachers, but to enhance teachers' instructional design capacity, thereby indirectly facilitating the generation of high-quality classroom dialogue.

Drawing on the theoretical perspective of dialogic teaching (Alexander, 2008; Mercer et al., 2019), this study examines how Generative Artificial Intelligence (GenAI) reshapes the structure of teaching interactions and learning processes in Chinese higher education classrooms. Unlike traditional research that conceptualizes AI as a tool for instruction or an efficiency-enhancing technology (Holmes et al., 2019; Kasneci et al., 2023), this study positions GenAI as a "structural mediator" of classroom dialogue and proposes a GenAI-Enhanced Classroom Dialogue Framework. This section discusses the findings at three theoretical levels and further explores implications for teacher professional development.

GenAI as a Structural Mediator of Dialogic Teaching

The primary theoretical contribution of this study lies in redefining the functional positioning of generative AI in classroom teaching. Existing literature typically frames AI as a content-generation tool or learning support technology (Dwivedi et al., 2023; Kasneci et al., 2023). However, the empirical findings of this study demonstrate that GenAI is deeply embedded in instructional design and classroom interaction processes, functioning as a "pedagogical cognitive mediator" that directly influences the structure, rhythm, and depth of classroom dialogue.

This interpretation is supported by multiple empirical findings. First, quantitative results show that after the introduction of GenAI, classroom participation significantly increased (+22.2%, $p < 0.001$), the number of contributions per class rose significantly (+2.1, $p < 0.001$), and the proportion of higher-order cognitive responses increased from 31% to 46%. This indicates that GenAI does not merely increase interaction frequency but enhances the cognitive quality structure of interaction.

Second, classroom observations further reveal a systematic transformation in teachers' questioning patterns, shifting from factual Q&A to multi-level cognitive sequences (Knowledge → Reflection), indicating a substantial restructuring of dialogic architecture. Based on these findings, this study argues that GenAI expands teachers' cognitive boundaries through three pathways:

- Question generation capacity
- Anticipatory pedagogical reasoning in classroom interaction
- Dialogic structuring capability

Importantly, GenAI does not replace teacher judgment but expands the teacher's "design space," enabling the construction of more complex dialogic structures at lower cognitive cost. Therefore, this study proposes a revision of the traditional teaching model:

- Traditional model: Teacher → Dialogue → Learning
- Revised model: Teacher → GenAI → Dialogue → Learning

This shift suggests that GenAI is no longer an external tool but an embedded structural generative mechanism within classroom teaching, fundamentally reshaping how classroom dialogue is produced.

Four Pedagogical Mechanisms of AI-Enhanced Classroom Dialogue

Based on the integrated analysis of qualitative and quantitative data, this study identifies four core mechanisms through which GenAI supports classroom dialogue, mapped onto Alexander's (2008) five principles of dialogic teaching.

Mechanism 1: AI-Assisted Lesson Design → Purposeful Dialogue

Teachers widely use GenAI for case generation, question prediction, and activity structuring, shifting classroom teaching from experience-driven to structure-driven design. This transformation enhances goal alignment and cognitive focus in classroom dialogue.

Observations show that AI-assisted classes involve fewer factual exchanges and more explanation, evaluation, and reflection, consistent with the significant increase in higher-order responses (+15%). This mechanism strengthens Alexander's principle of

Purposefulness, where dialogue becomes a structured cognitive pathway rather than spontaneous interaction.

Mechanism 2: AI-Supported Question Design → Reciprocal & Cumulative Dialogue
GenAI plays a key role in generating "questioning sequences," transforming classroom interaction from isolated Q&A into structured progressive dialogue. Interviews indicate that AI expands single questions into multi-layered sequences, extending discussion chains.

This mechanism is supported by quantitative findings showing increased student contributions (+2.1) and a higher proportion of student-led interaction (+13%). It strengthens:

- Reciprocity (increased interaction frequency and response diversity)
- Cumulativeness (knowledge construction through continuous dialogue)

More importantly, it transforms the temporal structure of classroom dialogue from linear Q&A into a cyclic generative cognitive process.

Mechanism 3: AI-Driven Personalized Support → Supportive Dialogue
GenAI-enabled personalized feedback significantly reduces students' speaking anxiety and increases participation among low-engagement students. This is consistent with subgroup findings, where low-engagement students' learning engagement increased from 2.91 to 3.05, while medium-engagement students declined (-0.11), indicating a redistribution effect.

This mechanism strengthens the Supportive principle by lowering participation barriers through cognitive scaffolding, thereby reshaping the psychological accessibility of classroom dialogue.

Mechanism 4: AI-Facilitated Collaboration → Collective Dialogue
In group learning contexts, GenAI serves as a shared cognitive tool, providing structured starting points for knowledge construction. Classroom observations show more structured group discussions, clearer task division, and more frequent use of AI-generated content as discussion anchors.

This mechanism extends the Collective principle. In GenAI-supported environments, collectivity is not only about co-participation but also about sharing an intelligent cognitive system as the basis for interaction, forming a socio-technical mode of collaboration.

Extending Dialogic Teaching Theory in the Age of GenAI
This study further extends Alexander's model of dialogic teaching. In the original framework, dialogic teaching can be simplified as:Teacher → Dialogue → Learning, assuming that teachers are the sole designers of classroom dialogue.

The key finding of this study is that this structure is fundamentally reconfigured in the presence of GenAI: Teacher → GenAI → Dialogue → Learning. This transformation has three theoretical implications. First, GenAI becomes a generative mediator of classroom dialogue, participating in the pre-structuring of interaction and reducing dependence on individual teacher capacity. Second, the mechanism of dialogue generation shifts from

teacher-centered design to human–AI co-design, expanding the reach and scalability of dialogic teaching. Third, Alexander's five principles (Collective, Reciprocal, Supportive, Cumulative, Purposeful) are reinterpreted as operational logics of a human-AI co-constructed system rather than pedagogical norms alone.

Accordingly, the GenAI-Enhanced Classroom Dialogue Framework demonstrates that GenAI does not directly affect learning outcomes. Instead, it reshapes classroom dialogue as a mediating mechanism, which in turn influences student participation, critical thinking, and collaborative ability. This finding moves beyond the dominant "technology-outcome" paradigm and emphasizes a "technology–dialogue structure–learning outcome" mediation pathway.

Implications for Teacher Professional Development

The findings suggest that effective use of GenAI depends not only on the technology itself but also on teachers' digital pedagogical competence. Therefore, teacher professional development should shift from traditional ICT training toward systematic cultivation of AI-enhanced teaching competencies. Specifically, four key dimensions are proposed:

1. **Prompt design literacy**: the ability to use prompts to generate high-quality instructional materials, including questions, cases, and learning tasks.
2. **AI pedagogical literacy**: understanding how to embed AI within instructional structures rather than using it merely as an auxiliary tool.
3. **AI ethics awareness**: identifying and managing issues such as data privacy, academic integrity, and student dependency.
4. **Dialogic facilitation competence**: maintaining depth, openness, and criticality in classroom dialogue when AI is present, rather than allowing AI to weaken student thinking processes.

Therefore, future teacher training systems should move from "technology use training" to "human–AI co-design capacity building" to support sustainable and responsible integration of GenAI in classrooms.

Conclusion

Grounded in dialogic teaching theory, this study uses mixed-method evidence from two Chinese universities to systematically examine how Generative Artificial Intelligence (GenAI) reshapes classroom dialogue mechanisms and influences teaching processes and student engagement. The study proposes and validates a GenAI-Enhanced Classroom Dialogue Framework, demonstrating that GenAI does not directly affect learning outcomes. Instead, it operates through embedding itself in instructional design processes, forming a human-AI co-generative pathway: Teacher → GenAI → Dialogue → Learning.

Specifically, GenAI enhances classroom dialogue through four core mechanisms: instructional design optimization, questioning structure reconstruction, personalized learning support, and collaborative learning facilitation. These mechanisms collectively improve classroom participation, interaction frequency, and higher-order cognitive responses, and partially improve the distribution of learning engagement.

The theoretical contribution of this study lies in redefining GenAI from a "teaching tool" to a "structural mediator of classroom dialogue" and extending Alexander's (2008)

framework toward a human-AI co-constructed dialogic model. Practically, the study offers actionable pathways for integrating GenAI in higher education, emphasizing that the key lies not in the technology itself, but in how it is used to reconstruct high-quality classroom dialogue structures. However, the study is limited by its sample scope and cross-sectional design. Future research could further examine the robustness and long-term effects of this framework in cross-disciplinary and longitudinal contexts, deepening understanding of AI-driven pedagogical transformation mechanisms.

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Artificial Intelligence in Personalised Learning

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Abstract

Artificial Intelligence is transforming modern education by supporting personalised learning for students. Personalised learning is an approach where teaching methods, content and learning speed are adjusted according to individual student needs, abilities and interests. Unlike traditional classroom learning, personalised learning focuses on each student's learning style and progress. This research article titled "Artificial Intelligence in Personalised Learning" aims to analyse how AI systems can assess students' performance data and learning behavior to identify their strengths and weaknesses. This paper also deals with how AI provides adaptive learning content, personalized feedback and customized assessments. This research paper would thus identify ways to help students learn at their own pace and improve their academic performance and understanding.

Keywords: Artificial Intelligence, Adaptive Learning, Educational Technology, Intelligent Tutoring Systems, Learning Analytics, Machine Learning, Personalised Learning,

Introduction

Education plays a vital role in shaping human development and societal progress. Traditional educational systems have largely followed a standardized teaching approach in which all students are taught the same content at the same pace regardless of their abilities, interests or learning styles. Although this approach has been effective for large-scale education, it often fails to meet the individual learning needs of students. Some students may struggle to understand concepts while others may feel unchallenged due to repetitive or slow-paced instruction.

In recent years, the rapid growth of technology has significantly influenced the education sector. Among these technologies, Artificial Intelligence (AI) has emerged as one of the most powerful innovations transforming teaching and learning processes. AI refers to the simulation of human intelligence in machines that are programmed to learn, reason, analyse and make decisions. In education, AI systems are used to collect and analyse student data, identify learning patterns and provide customized educational experiences. Personalised learning is an educational approach were learning content, teaching methods and assessments are adapted according to the individual needs of learners. AI makes personalised learning more effective by continuously monitoring student performance and modifying learning activities based on their strengths and weaknesses. Through intelligent systems, students receive personalised recommendations, adaptive quizzes, instant feedback and customised study materials.

AI-powered educational tools such as intelligent tutoring systems, virtual assistants and adaptive learning platforms are increasingly being integrated into schools, colleges and online learning environments. These systems help students learn at their own pace and improve academic performance. Teachers also benefit from AI because it reduces administrative workload, supports performance tracking and enables better instructional planning. The integration of AI into education became even more important after the growth of online learning and digital classrooms. AI-based platforms provide accessibility to students from different geographical and social backgrounds, enabling flexible learning opportunities.

Despite its numerous advantages, AI integration in personalised learning also raises several concerns. Issues related to data privacy, technological dependency, algorithmic bias and unequal access to digital resources remain major challenges. Therefore, it is important to understand both the opportunities and limitations of AI in education.
This research paper aims to explore the role of Artificial Intelligence in personalised learning, analyse its applications, identify its benefits and challenges and examine its future implications in modern education.

Review of Related Literature

- Several researchers have studied the role of Artificial Intelligence in education and personalised learning. Holmes, Bialik and Fadel (2019) explained that AI helps improve student learning through adaptive educational technologies and intelligent systems. Luckin et al. (2016) stated that AI supports customized learning experiences by analysing student learning behaviour and academic performance.
- Research studies also show that adaptive learning platforms and intelligent tutoring systems improve student engagement, motivation and academic achievement. AI-powered learning analytics help teachers identify struggling students and provide timely academic support. Previous studies further indicate that personalised learning environments improve flexibility, accessibility and independent learning among students.
- However, researchers have also identified challenges such as data privacy concerns, technological dependency and unequal access to digital resources. Therefore, proper implementation and ethical use of AI are essential for effective personalised learning systems

Objectives

The major objectives of this study are:

- To analyse the role of Artificial Intelligence in personalised learning
- To study how AI supports adaptive learning systems
- To identify the benefits of AI-based educational technologies
- To examine the challenges and limitations of AI in education

To understand the future implications of AI in personalised learning

Methodology

This study adopts a qualitative research methodology using a documentary research design to explore the role of Artificial Intelligence in personalised learning. The study mainly focuses on analysing existing literature, AI-based educational tools and adaptive learning technologies used in modern education systems.

Research Design
The research is descriptive in nature and aims to understand how Artificial Intelligence supports personalised learning in educational environments. The study does not involve primary data collection such as surveys or interviews. Instead, it is based on secondary sources that provide information about AI applications, adaptive learning systems and intelligent tutoring platforms.

Sources of Data
- The study uses secondary data collected from various reliable academic and educational sources. The major sources include:
- Peer-reviewed journals
- Research articles
- Educational reports
- Conference proceedings
- Scholarly books
- Government and institutional publications
- Online academic databases such as Google Scholar, IEEE Xplore and ScienceDirect
- These sources were selected based on relevance, credibility and recent developments in Artificial Intelligence and education.

Selection Criteria
The selected materials and documents focused on:
- Artificial Intelligence in education
- Personalised learning systems
- Adaptive learning platforms
- Intelligent tutoring systems
- Learning analytics
- AI-based assessment tools
- Studies related to modern educational technologies and student-centered learning approaches were prioritised.

Data Collection Method
The study is mainly based on secondary data collection methods. Information related to Artificial Intelligence in personalised learning was collected from various sources such as reference books, research journals, conference papers, educational reports and online academic databases including Google Scholar and IEEE Xplore. These sources provided detailed information about AI technologies, adaptive learning systems and intelligent tutoring tools used in education.

In addition, a simple offline survey was conducted among students to understand their awareness and opinion about AI-based personalised learning systems. The collected information focused on the applications, benefits and challenges of Artificial Intelligence in personalised learning. Various published studies and educational resources were carefully examined to understand how AI improves student learning experiences, academic performance and teaching effectiveness.

Analysis
The collected data were analysed using thematic analysis. Key themes and concepts were identified based on recurring patterns and insights from research articles, journals,

conference papers, educational reports and responses collected through a simple offline survey. The analysis mainly focused on the applications of AI in education, benefits of AI integration, challenges and limitations and the future implications of AI in teaching and learning. The study is guided by the learner-centered educational approach, which emphasizes adapting teaching methods, learning content and assessment strategies according to individual student needs and learning progress.

Tools and Technologies Studied

The study analysed different AI-powered educational technologies such as:

- Adaptive learning platforms
- Intelligent tutoring systems
- AI chatbots and virtual assistants
- Learning analytics systems
- Automated assessment tools
- Recommendation systems for educational content
- These technologies help provide personalised instruction and improve student engagement.

Limitations of the Study

The study is limited to secondary data and existing literature. Since no primary data collection was conducted, the findings are based on previously published studies and reports. Rapid technological advancements in AI may also lead to continuous changes in educational applications and practices.,

Findings and Discussion

The study reveals that Artificial Intelligence has significantly improved the quality and effectiveness of personalised learning in modern education. AI-based systems help students receive customised learning experiences according to their learning abilities, interests and academic performance. Unlike traditional classroom methods, AI-supported learning environments focus on individual student progress and continuous improvement.

The findings indicate that AI technologies enhance both teaching and learning processes through adaptive content delivery, smart feedback systems and performance monitoring. Students are able to learn difficult concepts more effectively with the help of intelligent educational tools. (

Table 1. Impact of Artificial Intelligence on Personalised Learning

Educational Area	Impact of AI in Personalised Learning
Student Learning	Provides customised learning materials based on student performance
Feedback system	Gives instant and continuous feedback to learners
Teacher Support	Reduces workload through automated grading and analytics
Remote learning	AI improves administrative efficiency and supports research and innovation.
Inclusive Education	Assists students with different learning needs and disabilities

Personalized Learning Experience

AI systems continuously monitor student learning patterns and modify educational content according to individual needs. Students receive personalized recommendations, practice exercises and study materials that match their learning speed and understanding level. This approach helps students gain better conceptual clarity and improves overall academic performance.

Smart Feedback and Assessment
AI-powered assessment tools provide immediate feedback after quizzes, assignments and online tests. Students can quickly identify mistakes and improve their understanding without waiting for manual evaluation.
Automated assessment systems also improve fairness and consistency in evaluation.

Increased Student Participation
Interactive learning platforms powered by AI make learning more engaging and student-friendly. Features such as gamified learning, adaptive quizzes and virtual learning assistants encourage active participation in educational activities.
Students show higher motivation levels when learning becomes interactive and customised.

Data-Driven Learning Support
AI systems analyse educational data such as attendance, test scores and learning behaviour to identify students who may need additional academic support.
Teachers can use this information to provide targeted guidance and improve classroom instruction.

Support for Flexible Learning
AI enables students to access learning resources anytime and anywhere through online educational platforms. This flexibility supports self-paced learning and benefits students from remote or underdeveloped areas.

Improvement in Teaching Efficiency
AI reduces repetitive administrative tasks such as grading, attendance tracking and report generation. Teachers can therefore focus more on mentoring, classroom interaction and academic planning.

Conclusion

- Artificial Intelligence is playing an important role in transforming personalised learning and modern education systems. AI technologies such as adaptive learning platforms, intelligent tutoring systems, learning analytics and automated assessment tools help create a more student-centered learning environment. Unlike traditional teaching methods, AI-based learning systems focus on individual student needs, learning pace and academic performance.
- The study reveals that AI improves student engagement, understanding and learning efficiency by providing customised educational content and continuous feedback. Students can learn at their own pace and receive additional support based on their strengths and weaknesses. AI also supports teachers by reducing administrative workload and helping them monitor student progress effectively.
- Furthermore, AI enhances accessibility and flexibility in education by supporting online and remote learning environments. It also promotes inclusive education by assisting students with different learning needs and disabilities.
- However, despite its advantages, the implementation of AI in personalised learning also faces challenges such as data privacy concerns, high implementation costs, technological dependence and unequal access to digital resources. These issues must be carefully managed to ensure ethical and effective use of AI in education.

- In conclusion, Artificial Intelligence has the potential to revolutionize personalised learning by creating smarter, more flexible and inclusive educational systems. With proper implementation, ethical safeguards and balanced integration with human teaching, AI can significantly improve the quality of education and support the development of future learners.

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The Quality of Family Life and its Impact on Developing Creativity in Children in Light of the Applications of Artificial Intelligence in Adaptive Education

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Abstract

This study aimed to discuss the concept of family quality of life in relation to fostering creativity in children. This was achieved by exploring the concept of family quality of life in light of artificial intelligence applications in adaptive learning and its implications for child-rearing practices. The study also discussed the importance of family quality of life in contemporary scientific guidelines, identified methods for promoting family quality of life to foster creativity in children, and examined the challenges that hinder the impact of family quality of life on children's creativity within the context of artificial intelligence applications in adaptive learning. The researcher employed qualitative research using relevant record-keeping tools to collect qualitative data, in addition to analysing the content of records linked to several studies related to family quality of life and its connection to fostering creativity in children. The study reached several conclusions, most notably that the Islamic legal guidelines regarding the characteristics and perceptions of family quality of life were clear and rich in various Islamic sources, and that there are significant difficulties in effectively utilizing them to foster creativity in children. It was also observed that many life practices related to family quality of life remain far removed from the applications of artificial intelligence in adaptive learning. The researcher recommended striving to provide guidance and awareness programs and services to educate parents in particular about contemporary methods to help children develop creativity through artificial intelligence applications in adaptive education within the framework of family quality of life.

Keywords: Artificial Intelligence Applications in Adaptive Learning, Creativity Development, Family Quality of Life, Quality of Life

Introduction

Sustainable Family life in many places has undergone unfamiliar changes and unprecedented transformations during the contemporary historical era. These changes and transformations have encompassed all aspects of family life, resulting in numerous familial and educational difficulties and problems, in addition to social and moral failures and exposure to various economic and cultural crises. Proponents of positive psychology have advocated for the application of quality-of-life principles in family practices and other areas, and the United Nations and several international organizations have adopted the approach aimed at integrating quality of life principles into various political and social fields. Experts consider quality of life to be a fundamental dimension of mental health,

not limited to a specific stage of an individual's life, but rather encompassing all stages of an individual's life (Maamaria, 2012; Mashri, 2014).

Some theorists believe that the psychological perspective on quality of life involves an individual's understanding of the meaning of their life, enabling them to invest and utilize their energies and potential positively. This means that any regulations that hinder this, whether within or outside society, are completely at odds with divine laws, human rights, and human dignity, regardless of any justifications offered or how dubious or unclear they may be interpreted. The fundamental principle is that all of an individual's values, principles, beliefs, knowledge, and attitudes should be channelled into behaviours that make them active, content, self-aware, and successful in all aspects of their life (Mashri, 2014; Abdel-Khaleq, 2008; Abdel-Aal and Mazloum, 2013). Many researchers focus on the subjective aspects of quality of life, which cover attitude towards life and ambition, positive feelings and satisfaction with oneself and one's life, striving to achieve one's goals, feeling independent, being able to establish positive and reciprocal social relationships with others, and feeling happy and enjoying life (Abu Halawa, 2010), (Sheikhi, 2014), (Baya, 2017), (Al-Zahraa, 2018).

The Quality-of-Life Program 2020 document in the Kingdom of Saudi Arabia defines quality of life as encompassing liability, lifestyle, infrastructure, transportation, housing, healthcare, economic and educational opportunities, security, social environment, recreation, heritage, culture, arts, sports, leisure, and social participation. Positive psychology is a branch of psychology that focuses on the principles and applications of quality of life. This focus reveals that many life difficulties negatively affect individual and social quality of life. Positive psychology is a science that focuses on the objective dimensions related to an individual's life, affecting their well-being, development, and empowerment, and providing them with protection from psychological, behavioural, and other problems (Khalil & Ibrahim, 2013; Muammarah, 2012). Creativity in early childhood is a cornerstone of developing children's intellectual and social abilities, and it is closely linked to their family environment and their capacity for self-learning and experimentation. The quality of family life plays a pivotal role in creating a supportive environment for the child. This includes emotional and cognitive support and the provision of appropriate resources, which increases opportunities for developing creative thinking skills.

At the same time, AI-based adaptive learning allows children to interact with educational content tailored to their individual abilities and interests, thus promoting self-learning, problem-solving, and innovative thinking. This research aims to study the relationship between the quality of family life and the development of creativity in children, while exploring the role of AI-powered adaptive applications in strengthening this relationship.

Review of Related Literature

Most of the problems children may face in their lives are related to their family life. Therefore, it is essential to ensure a high quality of family life to provide a high quality of life for children and adolescents. Mira and Rabah (2023) argue that many changes in family life have contributed to family disintegration, illegal immigration, accidents, parental unhappiness, and various moral problems. A study by Al-Furaih and Al-Dali (2024) also indicates that the quality of family life is related to self-confidence, which is a product of parental treatment and overall family quality. The quality of family life influences motivation, guidance, adjustment, dialogue, a sense of freedom and

independence, talent development, and the ability to cope with stress and difficulties. For some experts, the quality of family life means that individuals feel satisfied, happy, stable, and harmonious within the family, and that they receive family support (Dardir and Mustafa, 2019; Ben Saber and Ben Hamada, 2020; Al-Sayed, 2014).

Some empirical studies show a positive correlation between the quality of family life and the level of creative expression in children. Close parental involvement allows parents to observe their children's developmental characteristics, whether intellectual, emotional, or physical. Maria (2021) demonstrated the significant role of the family in fostering creativity in children. Families can compare their children's traits with those of children outside the family, particularly in areas indicative of talent, creative thinking, focus, conformity, problem solving, fluency, originality, idea generation, and imagination. According to some studies, a child's birth order, family size, parental age and educational/professional level, the quality of family relationships, and parenting styles all influence the potential for developing creativity in children within the family (Al-Abdali, 2010; Baza, 2007; Al-Adl, 2010; Al-Sayed, 2010; Moussa, 2015; Talaat, 2008).

As evidenced by numerous scientific opinions and field experiences, adequate care for a child during their early developmental stages stimulates their ability to be active and innovative, and helps cultivate their creativity (Abdul Wahab, 2016; Al-Shuaiel, 2011; Brown, 2009). Furthermore, several family factors contribute to fostering creativity in children. It has been shown that the quality of family life is directly related to the quality of life of a gifted child. This is in addition to its connection to self-efficacy, self-confidence, level of ambition, improved academic achievement, development of multiple intelligences, academic excellence, achievement motivation, and positivity (Ibrahim, 2017; Abu Kaif, 2016; Al-Bahiri, 2017; Abdul Latif, 2018; Aishawi, 2017; Al-Mutairi, 2017; Younis, 2015).

Family life characterized by frequent commanding behavior, harshness, overindulgence, child withdrawal and isolation, punishment, and weak, infrequent, or nonexistent dialogue with the child often has a limited or negligible impact on the development of creativity (Kamel, 2006). Educational and psychological studies indicate that family quality of life encompasses psychological stability, emotional support, material resources, and a nurturing learning environment.

These factors provide children with a safe space for experimentation and discovery, which is fundamental to fostering creativity (Hoffman, 2021). A stimulating environment with positive supervision supports problem solving, imagination, and the generation of new ideas—essential elements of early creativity. Furthermore, adaptive learning and artificial intelligence are interconnected in many ways. AI-based adaptive learning provides children with content tailored to their individual levels, interests, and abilities. These tools enable children to learn independently, experiment, and discover which enhances cognitive creativity and innovative skills (Pane et al., 2017; Luckin et al., 2016).

Despite significant advancements in adaptive learning and artificial intelligence (AI) tools, a gap remains in understanding how the quality of family life affects children's ability to develop creativity when using AI educational tools.

- Does a supportive family environment with resources and active participation enable a child to benefit more from adaptive learning?

- What is the actual role of AI applications in fostering children's creativity within the family context?
- How can AI and adaptive learning be integrated into family settings to develop comprehensive educational programs that promote creativity?

Based on the foregoing, the study's problem is confined to the following main question: What is the concept of quality of family life in relation to the development of creativity in children within the context of artificial intelligence applications in adaptive education? The following sub-questions stem from this main question:

- Q1- What is the concept of quality of family life as presented in scientific sources, and what are its implications for child-rearing approaches within the context of artificial intelligence applications in adaptive education?

- Q2- What is the importance of quality of family life in contemporary scientific approaches to childhood within the context of artificial intelligence and its applications in adaptive education?

- Q3- What are the methods for establishing quality of family life to enhance and develop creativity in children in light of artificial intelligence applications in adaptive education?

- Q4- What challenges hinder the ability of quality of family life to foster creativity in children within the context of artificial intelligence applications in adaptive education?

The Importance of the Study

The importance of this study stems from the following:

1. The quality of family life is one of the most important indicators of life satisfaction among children.
2. The quality of family life helps address or reduce disorders that hinder creativity in children, especially within the framework of contemporary artificial intelligence applications.
3. Caring for the new generation, achieving sustainable educational development, and fostering socialization require families to promote and cultivate creativity in children within the context of adaptive learning.
4. This study may provide valuable information and insights that can be used more deeply to develop children's creativity within the framework of artificial intelligence applications in adaptive learning.
5. The study's findings may open broader horizons for more comprehensive awareness and field studies in the future regarding supporting children's creativity through artificial intelligence tools and adaptive learning methods, including those related to supporting children's creativity through the use of family quality of life.
6. Parents and other relevant stakeholders may benefit from some of the ideas presented in this study in developing, practicing, and implementing methods that can consolidate or enhance the use of family quality of life to support children's creativity through integration with early childhood programs and artificial intelligence applications in adaptive learning.

Objectives

Study Objectives

This study aims to discuss the concept of family quality of life in relation to fostering creativity in children, specifically:

1. To identify the concept of family quality of life within the context of artificial intelligence applications in adaptive learning and its implications for child-rearing practices.
2. To discuss the importance of family quality of life in contemporary scientific approaches to childhood development within the context of artificial intelligence and its applications in adaptive learning.
3. To identify some methods for promoting family quality of life to foster creativity in children in light of artificial intelligence.
4. To identify the challenges of implementing artificial intelligence in adaptive learning that hinder the impact of family quality of life on fostering creativity in children.

Study Limitations

1. The study is limited in time by being conducted during the 2026 academic year.
2. The study is limited geographically by being conducted in the Kingdom of Saudi Arabia.
3. The study is limited thematically by focusing on understanding the concept of quality of family life and its implications for developing creativity in children in light of the applications of artificial intelligence in adaptive education

Study Terminology

The study addresses the following terms:

1. The Concept of Quality of Life

   Quality of life refers to an individual's level of satisfaction with their personal and social life, as measured by several indicators such as positive relationships, a purposeful life, personal development, independence, self-esteem, and social and psychological adjustment (Al-Zahraa, 2018). Mahmoud (2009) views quality of life as a concept related to an individual's level of mental health and their degree of satisfaction and life adjustment in terms of health, mental well-being, emotional well-being, physical well-being, professional well-being, and social well-being (Mahmoud, 2009). According to Al-Bahadli and Kadhim, quality of life means the ability to adopt lifestyles that satisfy an individual's desires and needs, leading to feelings of happiness, satisfaction, and enjoyment materially, socially, and spiritually (Kadhim & Al-Bahadli, 2006). Operationally, quality of life can be defined as a concept that indicates the extent of an individual's success in their personal and social life across various aspects.

2. Family Life Quality

   The concept of family life quality refers to the extent to which internal and external family aspects are present, including health, family relationships, beliefs, material well-being, and social support. It is a comprehensive concept encompassing all aspects of family life (Abdulwahab, 2016). Operationally, family life quality can be defined as a concept that indicates the extent to which family needs are met, the enjoyment of family members in their life together, their adherence to personal and family values, and the level of positive interaction among family members.

3. The concept of developing creativity in children
   A concept that indicates the family preparing the appropriate atmosphere for children that sharpens their various abilities and skills, and adopting and supporting their unfamiliar ideas that go beyond traditional ways of thinking, and their continuous encouragement of children to present, discuss, innovate and inspire, or what is sometimes referred to as supporting ideas outside the box.

4. Artificial Intelligence (AI) Applications
   AI applications are software systems and tools that use machine learning algorithms, data analysis, and user interaction to perform educational, cognitive, or practical tasks in a way that mimics human capabilities (Luckin et al., 2016). In the context of education, these applications include:
   - Educational recommendation systems
   - Adaptive learning programs
   - Interactive educational robots
   - Real-time assessment and feedback tools

   The importance of this term lies in the fact that these applications provide children with personalized and interactive experiences that support the development of creativity and problem-solving skills in accordance with the child's level and interests (Luckin et al., 2016; Chen and Lin, 2020; Holmes et al., 2019).

5. Adaptive Learning
   Adaptive learning is an educational approach that tailors content and learning activities to each learner's individual characteristics, such as their level of knowledge, learning pace, and preferred learning style (Pane et al., 2017). Its key features include providing graded content according to the child's level, immediate feedback to correct errors, interactive and personalized learning activities, and integrating digital tools and artificial intelligence (AI) technologies to enhance the learning experience.

The importance of this term lies in the fact that it:
Supports the development of creativity in children by providing appropriate challenges that suit their abilities; allows for self-directed learning and discovery; is fundamental in early childhood; and enhances children's learning with AI tools in an individualized and appropriate manner (Lukin et al., 2016; Pane et al.; Holmes et al., 2019). In general, adaptive learning represents the educational framework for AI applications, meaning that AI tools implement the adaptation process and analyze the child's data to provide a stimulating and creative learning experience.

Methodology

This study employs qualitative research through record-keeping. The researcher monitors, preserves, categorizes, and organizes available documents and records related to the study topic to serve its objectives.

Qualitative research allows for the collection of non-numerical qualitative data and helps explore decision-making processes through a detailed perspective. The collected information is comprehensive, accurate, and rich, and the results emerge through rigorous analysis (Al-Quraini, 2020; Creswell, 2022). Qualitative research allows for data analysis using contextual analysis techniques, drawing conclusions from these techniques, and

textual analysis of the collected records or documents. This record-keeping approach helps in obtaining highly accurate, in-depth, and realistic insights.

Previous Studies

Al-Furaih and Al-Dali' conducted a study in 2024 on the quality of family life and its relationship to self-confidence among gifted students. The study aimed to reveal the relationship between the quality of family life and self-confidence among gifted students. The study adopted a descriptive correlational approach and was applied to a sample of 239 gifted students in Mawhiba schools. The Family Life Quality Scale was administered, and the results indicated that the quality of family life among the students was high, with statistically significant differences in the variables of parental educational level and gender.

In 2016, Abdel Wahab conducted a study on the quality of family life and the development of children's creative abilities. The study aimed to monitor the quality of family life as perceived by children and its relationship to the development of their creative abilities. The study relied on the descriptive documentary method. The results of the study showed that there is an importance in satisfying the child's needs within the family in order to stimulate his creative abilities, and that the quality of family life is one of the strongest indicators of life satisfaction among children, which supports his special and creative abilities. Also, developing the spirit of creativity in children helps in forming the personality of the son or daughter and enables him to achieve and develop, and overcome all obstacles that hinder creativity within the family, taking into consideration that the quality of family life is not dependent only on parenting methods, but is a comprehensive concept that includes all aspects of family life.

In her 2021 study on the role of the family in developing creativity in children, Maria indicated that methods of motivating children to be creative include encouraging individual differences in their inclinations and abilities and working to support them, identifying the areas of creativity in children and continuously supporting their positive attitudes towards creativity, avoiding criticism and ridicule of shortcomings, encouraging children to make independent decisions, independence in thinking and freedom of choice, following the method of dialogue and discussion, making the child feel safe and secure, avoiding harshness and severity in dealing with children, avoiding excessive pampering of children, rejecting all methods of neglecting, marginalizing and not caring for children, avoiding discrimination in treatment between children, striving to make the child go through diverse experiences in order to practice his ideas and creativity, in addition to motivating the child to love curiosity, exploration and self-confidence.

In 2020, the Al-Kafeel Family Centre conducted a scientific study on the role of the family in fostering creativity in children. The study's findings indicated the crucial importance of families training children to think, imagine, ask questions, and respect and take their questions seriously. It also highlighted the need to provide ample stimulation that engages the child's senses and thinking, spend sufficient time with them daily, instil confidence in their abilities, train them in anticipation and prediction, and create an atmosphere of freedom, respect, and harmony within the family. This involves fostering affection and tenderness, avoiding harshness, violence, and constant reprimands, and using mistakes as stepping-stones to improvement. Furthermore, the study emphasized the importance of encouraging participation, positive behaviour, and the expression of ideas, as well as fostering acceptance of change. It also stressed the need to appreciate the inherent

creativity bestowed by God Almighty upon all creation. Providing a small home library to support children's intellectual and scientific research activities, along with training them in listening, reflection, and contemplation, may be beneficial.

In 2024, Bal-Khair conducted a study on innovation and creativity from an Islamic perspective and its role in the upbringing of learners. The study's findings indicated that one of the key elements for educators to successfully cultivate creativity in children is their persistent effort to encourage children to engage in creative activities and to think scientifically and reflectively through fluency, originality, and flexibility, which are considered components of creative thinking. In 2021, Othman stated that the family plays a fundamental role in discovering creative and talented individuals, as it is the child's first environment. He emphasized that the family must monitor and follow up on the child's development, objectively evaluate it, provide a suitable environment for creativity, address the child's various problems, provide opportunities to stimulate creativity, and offer appropriate incentives.

In 2020, Al-Omari conducted a study on the quality of family life and its relationship to achievement motivation among a sample of male and female high school students in Jeddah. The study aimed to identify this relationship and reveal the impact of several variables (gender, academic specialization, family size, parental education level, and family income) on both family life quality and achievement motivation. The study sample consisted of 764 male and female students, and the researcher used the Family Life Quality Scale and the Achievement Motivation Scale. The results showed a statistically significant correlation between family life quality and achievement motivation, and that parental education level, academic specialization, and family income all influence achievement motivation. In a 2016 scientific article on the role and responsibilities of the family in child development, Al-Ghani explained that this role requires providing a suitable family environment for the child's growth in all its dimensions, and avoiding all forms of words and actions that negatively affect the child. This role also necessitates training the child in research, inquiry, participation, identifying sources of information, imagination, and mental visualization of events and situations. It also involves granting the child freedom to be creative and expressive, increasing the child's self-confidence and sense of security, and encouraging their curiosity.

In his research on the family and its role in fostering creativity, Al-Adwani emphasized the importance of developing family relationships based on love and respect, avoiding intimidation tactics, cultivating a spirit of tolerance and forgiveness, encouraging the child to use imagination and transcend the familiar and tangible, and fostering free movement with humour and playfulness. He stressed the importance of raising the child's expectations of their children while being careful not to exaggerate praise or favour the creative child over others. In 2018, the engineer concluded that the family plays a crucial role in fostering creativity in children. He noted that there are different family models, ranging from tolerant and flexible to strict and rigid.

A family can encourage creativity and innovative thinking in children if its characteristics foster curiosity, encourage interaction with the environment, provide stimuli that create opportunities for creativity, employ dialogue and understanding, and avoid repressive methods in its interactions with the child. In 2011, Al-Khatib conducted a study on the family's role in developing talent and creativity in children. The results highlighted the necessity of preparing families with various factors that stimulate their children's creative

activities. Similarly, in a 2020 article on the family's role in fostering creativity in children, Al-Shayadi explained that the family is primarily responsible for shaping a child's behaviour and thinking patterns. He emphasized the importance of treating the child within the family as a valued member with the right to participate, be educated, and receive awareness, while taking their age into account. This, he argued, broadens the child's horizons and enhances their intelligence and perceptiveness.

In 2023, Ben Aouda conducted research on the role of the family in developing creative thinking in children, demonstrating that the family plays a fundamental role in a child's life, personality, and future. Similarly, in 2013, Al-Tunisi conducted research on the role of the family in developing creativity in gifted children. The results showed that the family plays a role in developing the abilities of gifted children because it is the primary social environment in which the child grows and where their physical, psychological, and social needs are met. It also represents the basic framework for social interaction between the child and other groups. For the family to fulfil this role, it needs to expand its capacity to gather information and data about the nature and characteristics of the children within it, as well as methods for early detection of giftedness.

A 2023 study by Mira and Rabah on the quality of family life in Algeria revealed that contemporary family life has declined under the influence of various internal and external pressures, undoubtedly having a significant impact on childhood and various segments of the population. A 2021 study by Hoffman demonstrated that the quality of family life positively influences creativity. This underscores the potential for families, through their diverse activities and integration with AI tools related to adaptive learning, to achieve significant progress in this area.

Furthermore, a 2016 study by Luckin and colleagues showed that AI tools enhance adaptive learning and creative thinking. The results of a 2017 study by Pane et al. showed that adaptive learning improves individual performance. Furthermore, Abdullatife's 2024 study demonstrated that knowledge of AI tools and trust are key factors in adopting learning tools. Sternberg's 2018 study also revealed that a stimulating environment is fundamental to fostering creativity, thus framing the relationship between family and creativity.

Theoretical Framework

Introduction

Early childhood forms a foundational stage for intellectual, social, and emotional development in humans. It is characterized by flexible development and a high capacity for learning. One of the most important criteria that researchers seek to develop during this stage is creativity, which is considered an indicator of the ability to innovate and solve problems in unconventional ways (Sternberg & Lubart, 1999). Creativity is linked to multiple factors, most notably the family environment, which provides emotional and cognitive support and interactive sessions with the child from their earliest years. At the same time, the digital revolution has led to the use of artificial intelligence (AI) technologies in education, particularly in adaptive learning, which allows for the personalization of educational experiences according to the abilities and needs of learners (Holmes, Bialik & Fadel, 2019). This research framework poses an important question: How does the quality of family life contribute to enhancing creativity in children in light of the use of AI applications in adaptive learning?

Basic Concepts

Family Quality of Life

Family Quality of Life is a concept that describes the extent of a family's life satisfaction and the presence of a supportive environment that meets the psychological, social, and cognitive needs of its members (Summers et al., 2005).

Quality of life includes:

- Emotional stability
- Family support
- Access to educational resources
- Shared interaction among family members

Quality of life influences the family's ability to create a stimulating environment for learning and exploration.

Creativity in Children

In the psycho-educational context, creativity is defined as the ability to produce new, appropriate, and useful ideas or solutions (Runco & Jaeger, 2012). In children, creativity manifests itself in play, imagination, questioning, and unexpected solutions to learning situations. Creativity is influenced by individual factors (such as curiosity and self-confidence) and environmental factors (such as family support and educational practices) (Beghetto & Kaufman, 2010).

Adaptive Learning Supported by Artificial Intelligence

Adaptive learning is an educational approach that relies on analyzing learner data to provide content and teaching methods that suit each individual's level (Pane et al., 2017). Artificial intelligence in education refers to systems and technologies that use intelligent algorithms to analyze learner interaction and personalize the learning experience, such as adaptive recommendations, real-time feedback, and intelligent assessment tools (Luckin et al., 2016).

The Theory of a Supportive Environment for Creativity

This theory asserts that creativity develops in environments that stimulate exploration, provide diverse resources, and support experimentation and self-directed learning (Stemberg & Lubart, 1999).

The theory's relevance to our topic:

- A family with a high quality of life provides a supportive environment.
- Adaptive and intelligent education enables self-directed and interactive learning experiences.

The Theory of Adaptive Learning

This theory is based on the premise that effective teaching must adapt to the characteristics of learners, and that intelligent technology can facilitate this adaptation (Pane et al., 2017). In the context of early childhood, this approach enables children to learn according to their individual needs and abilities.

Technology Acceptance Model (TAM)

According to TAM, perceived usefulness and perceived ease of use are the two main determinants of the acceptance of a new technology (Davis, 1989).

How does this relate to our research?

- Perceived Usefulness: The extent to which families and teachers believe that artificial intelligence benefits a child's learning.
- Ease of Usefulness: The extent to which teachers and children believe they can use AI tools.

The Relationship between Variables

The Impact of Family Quality of Life on Creativity

Studies indicate that a supportive family environment fosters creativity by providing:

- Knowledge resources (books, educational activities)
- Emotional support
- Opportunities for thinking and problem-solving

A study by Hoffman (2021) indicated that a high quality of life is associated with higher creativity skills in children.

The Impact of AI-Powered Adaptive Learning on Creativity

Studies have found that using intelligent adaptive learning provides:

- Challenges appropriate to children's abilities
- Opportunities for repeated exploration
- Immediate feedback

This contributes to enhancing creative thinking and problem-solving skills (Homes et al., 2019).

The Interaction Between Family Quality and Adaptive Learning

The quality of family life can enhance the impact of intelligent adaptive tools by:

- Encouraging children to use intelligent systems
- Supporting learning outside the classroom
- Guiding children towards creative, technology-supported activities

The Importance of Family Life Quality in Contemporary Scientific Approaches to Childhood

As experts see it, quality of life is an integrated concept that affects children based on the quality of their family life and other factors. For a child to experience a quality of life, they need many elements that contribute to its well-being, most importantly a sense of security and safety, continuous support, appreciation, family and community care, a feeling of worth and status, and receiving proper family, school, and community education (Zidan, Saad El-Din, & Sadiq, 2023; Al-Zahraa, 2018; Abdel Fattah, 1442 AH). Among the most important difficulties that negatively affect the quality of family life and its repercussions on children are the differences between spouses in behavior and patterns regarding the means of socializing children, the difference in values and customs between spouses, the decrease in feelings of affection and cooperation between spouses, acute emotional problems, many cultural backgrounds, problems of social roles, financial and material difficulties, health crises, the absence of dialogue and common language, the evasion of family responsibilities by one or both spouses and overburdening one of the parties, the problems of imprisonment, immigration and illness, and the negative view of women or men (Al-Yaman, 2020). Furthermore, the long duration of spinsterhood, family conflicts, the practice of domestic violence, divorce, family disintegration, the deviance of some family members, especially children, the severing of kinship ties, illicit sexual practices, and the drift or rush towards temptations, stimuli, fashion, comparisons, the pride of the wife or husband, and the stubbornness between them, all of this has severe

repercussions on children that disrupt their positive intellectual, social, and psychological development (Qadira, 2017). Factors that hinder the quality of family life, as reflected in the children's lives, include unjustified polygamy, the inability to treat wives equitably, frequent criticism of one another by spouses, and the neglect of marital and familial duties (Mohammadi & Bouaicha, 2013).

Rafie believes that the socialization of childhood is based on the objectives of the social policy of Sharia in securing childhood, and the legislative objectives of the social policy of Sharia in securing childhood (Rafie, 2019). According to many experts, the quality of family life is derived from the quality of life. Therefore, the concept of well-being, satisfaction of needs, improvement, and so on can be observed in the context of the quality of family life, taking into account that the concept of the quality of family life is still not defined. However, the principle of family life in supporting children and securing their mental and social development is a very fundamental principle. The quality of family life, in its reflections on children, is related to the level of communication within the family, family happiness, parental relationships, positive parental control, taking responsibility, and the ability to satisfy needs, the parental instinct, health, safety, family resources, and family support for people with special needs. In order for the family to succeed in developing creativity in children, it needs to form a positive self-concept in the child (Kharoubi, 2018), (Abu Halawa, 2010). It has become clear that the quality of family life influences a mother's ability to discover and nurture multiple intelligences in preschool children (Khader & Mabrouk, 2011).

Several theories demonstrate the importance of family life quality in fostering creativity in children, particularly within the context of AI applications in adaptive education:

1. The Creativity Supportive Environment Theory (Sternberg, 2008)
    - This theory states that creativity develops when the environment is stimulating, supportive, and resource-rich.
    - This can be linked to the family providing emotional support and AI providing cognitive support.
2. Adaptive Learning Theory
    - This theory states that tailoring learning to a child's abilities contributes to improved performance and the development of creative critical thinking.
    - This aspect enhances a child's creativity through experimentation and problem-solving.
3. Positive Child Development Theory
    - This theory indicates that an environment rich in opportunities, social support, and intellectual stimulation increases creative and cognitive abilities.

Table1: The Relationship between Family Life Quality and Artificial Intelligence Applications in Adaptive Education Can Be Illustrated Through The Following

Side	Quality of family life	Adaptive learning and artificial intelligence	Relationship
Supportive environment	The family provides a safe emotional and cognitive environment.	Smart learning systems provide a personalized and progressive learning environment.	Both create a stimulating environment for discovering new ideas.
Resources	Family resources include books, activities, and educational games.	Diverse and multimedia AI content (games,	It allows the child to interact with diverse

		videos, interactions) is available.	resources and fosters creativity.
Participation	Parents interact with their child in learning activities.	Parents can be integrated into AI platforms to monitor progress and interact.	Collaboration between family and adaptive education increases
Feedback	The family provides immediate and motivating feedback.	AI systems provide real-time feedback based on the child's level.	The blended approach increases opportunities for experiential and creative learning.
Developing problem-solving skills	The family encourages critical thinking and independence.	AI tools offer tailored approaches and innovative solutions.	The coordination between family support and smart technologies enhances innovation.

Quality of family life and its impact on children's creativity in the context of artificial intelligence and adaptive education

One of the most frequently addressed topics in psychology is social learning, which involves investigating how the learning process occurs in the real world, not in a psychology laboratory. Some proponents of social learning theory have sought to combine ideas from other theories, such as psychodynamics and behaviorism, within the context of human development. They believe that the interaction of basic human motives with learning mechanisms is a fundamental source for explaining how learning occurs. Many new ideas emerged in the research of Bandura, Walters, and others who focused on the importance of reinforcement and showed that children use cognitive processes and language to learn appropriate responses, problem-solving methods, and various behavioral patterns by observing others around them in the environment and also through external influences such as media materials and their means. Many ideas in this regard were developed by Piaget, the author of the theory of cognitive development in children, who saw those children from the age of four to the age of seven, which is the period of intuitive thinking, begin to develop the ability to deduce, form concepts, and generalize in a simple way. They may perceive relationships between causes and effects without being able to understand or explain them. This means that during this period, the child's mental abilities develop while the learning process continues through assimilation and adaptation, and their perceptions expand greatly. However, they do not have the ability to think abstractly until the age of ten and beyond. Psychologists believe that children have an increasing ability to think about abstract concepts and theoretical or mental thinking about what things could be, not what they actually are. If a family wishes to align with the principles of a high quality of family life, it must engage with the child beyond abstract concepts, adopting a gradual approach to intellectual development to help the child cultivate their creativity. It is worth noting that behavioral problems in children are often a result of environmental disturbances rather than inherent issues within the child themselves. The family serves as the child's primary environment and plays a crucial role in their upbringing through love, emotional support, security, training, and care. Almost all children need to feel wanted, cared for, protected, cherished, and valued. This includes a sense of acceptance and belonging, learning and guidance, and satisfaction derived from engaging in meaningful and creative activities.

Therefore, psychologists believe that positive parenting methods include firmness without rigidity or harshness, guidance and direction without resorting to commands, and

striving to provide suitable environmental conditions for mental and physical development. This involves providing a parental model characterized by trust, security, clarity, and equal authority between parents in complementary rather than competitive roles, encouraging children's autonomy, and understanding the patterns of family interactions that lead to problems in children. A closed or conservative family may stifle opportunities for children's creativity and may drive them to seek support from outside, especially if they receive conflicting instructions from different sources simultaneously. The quality of family life, in its impact on children's creative development, is negatively affected by overprotection or rejection, marital discord or dissatisfaction, a spouse lacking autonomy or authority, or divorce. At the same time, respecting emotional bonds, maintaining objectivity, empathy, appreciation, personal flexibility, and cooperation are among the most important characteristics of a high-quality family life that contribute to the development of creativity in children. It is noteworthy that the effects of family disturbances do not affect all family members equally, and sometimes children themselves have a strong influence on their parents. The changing structure of the modern family, the emergence of the heterogeneous family model, the increasing phenomenon of working mothers, and the growing diversity of ethnic and cultural differences within families can negatively impact the quality of family life and hinder the development of creativity in children (Arabization and Translation Committee, 2007).

Thus, it is clear that the concept of the quality of family life and its impact on the development of creativity in children is one of the most frequently addressed concepts in psychological and cognitive theories regarding its effects on intellectual development and other areas of cognitive, physical, emotional, and social growth.

Methods for Strengthening Family Life to Foster Creativity in Children in Light of Artificial Intelligence and Adaptive Education

Experts and practitioners, including scholars, intellectuals, and parents, have discussed numerous ideas and applications aimed at strengthening or enhancing the quality of family life to foster creativity in children. These methods encompass aspects related to the children themselves, others to the parents, and still others to the family and external environment as a whole. Family harmony and a healthy atmosphere remain the core characteristics of a high-quality family life that influence children's creativity. This includes the effectiveness of the child-parent relationship, active parenting, the child's perception of the parents, the emotional factor, and even the religious aspect of the family. Field experiences show that parental methods of behavior management, reward and punishment within the family, parental socialization techniques, child participation, shared goals, and mutual understanding all contribute to the desired family quality that supports the development of creativity in children (Al-Zahraa, 2018). According to some experts, the quality of family life is determined by a number of internal and external factors. Internal aspects encompass how the family perceives itself functionally in terms of health and family relationships, as well as cultural and religious beliefs. External aspects include material well-being and support. Principles of family quality of life include the degree to which the family's needs are met and the extent to which all family members enjoy life.

The level of adherence to personal and family values, the degree of interaction, and the potential for positive application of these values in family life all help the child to examine matters more closely, see them in different and unfamiliar ways, raise their level of thinking, and reject stereotypical thinking (Abdul Wahab, 2016). Table (2) illustrates the

results of the content analysis of a set of methods that support the quality of family life for creativity in children, based on the content analysis of 30 studies.

Table 2: Methods of Supporting Family Life Quality for Creativity in Children Using Content Analysis of Scientific Research and Studies

No.	style	repetition	%
1	Training the child to think	18	%60
2	Encouraging the child to analyze, ask questions, and take questions seriously	11	%36
3	Providing a variety of engaging and educational toys and games, and encouraging participation in play and group activities	8	%26.6
4	Increasing stimuli that engage the senses and stimulate thinking	9	%30
5	Parents should dedicate time to spend with the child daily	10	%33.3
6	Creating a family atmosphere of freedom, respect, and harmony	22	%73.3
7	Avoiding strict accountability methods and constant criticism	19	%36.3
8	Participating in the child's interests and activities	7	%23.3
9	Encouraging the child's positive behavior	6	%20
10	Giving the child confidence in themselves and their abilities	14	%46.6
11	Training the child to anticipate and predict	15	%50
12	Developing and creating opportunities for the child's creativity	27	%90
13	Purchasing scientific journals and appropriate resources	4	%13.3
14	Helping the child accept change	9	%30
15	Helping the child realize that some problems have more than one solution	7	%23.3
16	Helping the child realize that some problems have more than one solution	3	%10
17	Praising and appreciating the child's ideas without exaggeration or spoiling them	12	%40
18	Freeing the child from fear of failure and the expectation of ridicule from others		%70
19	Instilling the importance of developing and improving common and familiar aspects of life	8	%26.6
20	Training the child in good listening skills and enabling them to develop fluency, oratory, and presentation skills	7	%23.3
21	Teaching the child, the principle that success comes from God Almighty	3	%10
22	Effectively using positive reinforcement with the child	13	%43.3
23	Keeping the child away from family conflicts	18	%60
24	Ensuring good coordination and communication between the family and the school	4	%13.3
25	Encouraging the family to use brainstorming strategies with the child	7	%25.3
26	Developing the child's reasoning, inductive, deductive, classificatory, and organizational skills	9	%30
27	Strengthening the child's verbal and intellectual flexibility and originality	7	%23.3
28	Promoting the child's freedom of expression	11	%36
29	Providing the child with positive feedback on various topics	5	%16.6
30	Involving the child in family decision-making	16	%36
31	Helping the child appreciate and accept other opinions without compromising their rights.	11	%36
32	Not focusing solely on creative decisions.	8	%26.6
33	Training the child in a spirit of calculated adventure	4	%13.3
34	Encouraging individual differences in inclinations and abilities among children in the family	8	%26.6
35	Using dialogue and discussion with the child	11	%36
36	Avoiding neglecting or marginalizing the child	17	%56.6
37	Exposing the child to diverse experiences	15	%50
38	voiding favoritism in the treatment of children within the family	20	%66.6
39	Raising the family's expectations for children's performance	16	%36
40	Developing the child's curiosity	23	%76.6

41	Supporting the child's independence in thinking and choosing	25	%83.3
42	Encouraging self-directed learning in the child	11	%36
43	Protecting the child from anything that hinders their thinking and impedes their intellectual fluency	13	%43.3
44	Teaching the child that ideas are flexible, not rigid	7	%23.3
45	Allowing the child to experiment with things	5	%16.6
46	Developing the child's sensitivity to problems and motivating them to find solutions	8	%26.6
47	Regular family monitoring and objective evaluation of the child to discover their abilities and talents	10	%33.3
48	Avoiding rushing the desired or expected results from the child's understanding and performance	6	%20
49	Providing family cultural programs to support creativity in children and improve the quality of family life	2	%6.6

The table reveals a reasonable consensus regarding some methods for fostering creativity in children from a family quality of life perspective, although some methods are more widely adopted than others. The data indicates that fostering and creating opportunities for creativity within the family ranked first among the methods used to develop creativity in children, a finding that aligns with most of the analysed studies. The relatively low percentages of some methods do not imply their ineffectiveness or unsuitability for application. Certain family situations necessitate the use of specific methods to support children's creative development. Perhaps a larger number of studies would have increased the number of these methods identified.

The Challenges Facing the Impact of Family Quality of Life on Children's Creativity Development in the Context of Artificial Intelligence and Adaptive Education

While some may not see a direct relationship between parental education level and family quality of life or children's creativity development, field research indicates that formal or informal parental education plays a key role in children's development, education, and improving family quality of life (Al-Abdali, 2010; Al-Sadawi, 2016).

Generally, scholars believe that obstacles to creativity include a lack of knowledge or its inaccuracy, lack of proficiency, lack of encouragement, and preoccupation with worldly matters at the expense of essential aspects such as raising and caring for children. This also includes neglecting gifted, creative, or high-achieving children. Furthermore, flawed parenting methods within the family are among the greatest obstacles to developing children's creativity. Table (3) presents the content analysis results of 35 studies that addressed creativity development and its relationship to family quality of life.

Table 3: Obstacles to Creativity Not Revealed By Content Analysis of Studies

No.	Obstacles (Challenges)	repetition	%
1	Family breakdown	13	%37.1
2	Illegal immigration	3	%8.5
3	Low level of parental care for children or one or both parents	11	%31.4
4	Deficiencies in parenting	21	%60
5	Negative emotions and behaviors in children	23	%65.7
6	Raising children with punitive and aggressive behaviors	14	%40
7	Reliance on ineffective parenting methods within the family	28	%80
8	Inequality, favoritism, and discrimination among children	17	%48.5
9	Inconsistent parenting and lack of consistency in appropriate methods	13	%37.1
10	Overprotective parenting	22	%63.8

11	Imbalance between the mother's personal life and work	4	%11.4
12	Loss of a parent or parental separation	10	%28.5
13	Psychological disorders, social withdrawal, and emotional instability	15	%43.8
14	Problems stemming from illiteracy, ignorance, unemployment, and decreased productivity	9	%25.7
15	Drug and alcohol abuse	3	%8.5
16	Engaging in deviant or criminal behavior	4	%11.4
17	Loss of authentic cultural identity	8	%22.8
18	Unhealthy structure of family roles	9	%25.7
19	Inequal emotional interaction	5	%14.2
20	Conflicting parenting styles and behaviors	13	%37.1
21	Differences in cultural backgrounds, values, customs, and traditions between the spouses.	12	%34.2
22		17	%48.5
23	Decreased feelings of love, affection, and cooperation from the parents.	2	%5.7
24	The wife's irritability and pride.	25	%71.4
25	Financial and economic problems.	30	%85.7
26	Emotional and sexual incompatibility, jealousy, and infidelity.	7	%20
27	Problems in relationships with relatives.	9	%25.7
28	Health problems (chronic illness, disabilities, infertility).	8	%22.8
29	The wife's entry into the workforce.	7	%20
30	Problems related to divorce or separation.	5	%14.2
31	Parental bias (or bias towards the child's gender)	4	%11.4
32	Polygamy	3	%8.5
33	Problems related to differing parenting styles across generations	28	%80
34	Excessive religiosity	5	%14.2
35	Disparities in educational level between spouses	8	%22.8
36	Age differences between spouses	7	%20
37	Certain genetic or environmental factors	5	%14.2
38	Discouragement of learning and exploration	11	%31.4
39	Negative comments and ridicule of the child's ideas and creative attempts	19	%54.2
40	Instilling fear and shyness towards adults and authority figures	12	%34.2
41	Discouraging the child from expressing their opinion and viewpoint	19	%54.2
42	Following the rote learning method in education	6	%17.1
43	Treating information presented to the child as unquestionable truths	5	%14.2
44	Not giving the child the opportunity to lead and plan	6	%17.1
45	Accustoming them to dependence and subservience to others	5	%14.2
46	Imitation, blind imitation, and intellectual rigidity	6	%17.1
47	Inability to learn	3	%8.5
48	Poor or insufficient motivation	20	%57.1
49	Indifference to the child's interests	17	%48.5
50	Low intelligence and abilities	9	%25.7
51	Inferiority complexes in their various forms	4	%18.3
52	Delayed childbearing	2	4%5.7
53	Constant fear of failure	4	%18.3
54	Unjustified perception of others' criticism	2	%5.7
55	Constantly making excuses	3	%8.5
56	Family size	6	%17.1
57	Child's birth order	5	%14.2
58	Parental age	4	%11.4
59	Low parental education level	23	%65.7
60	Introversion, isolation, shyness, hesitation, and peer-related problems	11	%31.4

The table reveals numerous challenges and obstacles that can hinder the positive impact of family life quality on children's creativity. Emotional and sexual incompatibility, jealousy, and infidelity are among the most significant factors negatively affecting family life quality. Furthermore, children's negative emotions and behaviors, inadequate parenting, reliance on

ineffective parenting methods, parental over-protection and excessive attention, and insufficient or inadequate stimulation within the family are major impediments to the positive influence of family life quality on children's creativity.

Findings and Discussion

The researcher reached several conclusions, most notably:

1. Many parents lack an understanding of the meaning of quality of family life and its applications in artificial intelligence and adaptive learning.
2. Many practices in family life remain very traditional despite the changes that have affected contemporary family life. This traditional tendency misses opportunities to develop children's creativity through artificial intelligence and adaptive learning tools.
3. Developing creativity in children requires family interaction and integration, which is an essential part of quality of family life in the context of artificial intelligence and adaptive learning applications.
4. High quality of family life is associated with increased creative abilities in children.
5. Using adaptive AI applications enhances the effectiveness of children's learning and the development of their creative skills.
6. Interaction between the family and smart devices leads to a noticeable improvement in problem-solving and innovative thinking.

Study Recommendations

The researcher recommends the following:

1. Developing guidance programs for parents on effectively utilizing the principles of quality family life to foster creativity in children, in relation to artificial intelligence tools and adaptive learning.
2. Taking measures to monitor developments in contemporary family life and their impact on children's creativity.
3. Addressing the topic of ensuring quality family life in relation to children's socialization in formal and informal forums, on social media, and in other media outlets, linking it to modern scientific trends.
4. Leveraging successful international experiences in effectively utilizing quality family life to foster creativity in children, in light of applications of artificial intelligence tools and adaptive learning.
5. Designing educational programs that connect families, schools, and smart devices.
6. Training teachers in adaptive learning using artificial intelligence, taking into account the characteristics of each child.
7. Providing a supportive family environment and encouraging parental participation in the learning process.
8. Integrating creative activities into adaptive learning content to promote innovative thinking.

Conclusion

This study highlights the importance of communication as a decisive factor in bridging the gap between traditional vocational education and the digital requirements of the pharmaceutical industry. By applying Lasswell’s communication model, it illustrates how structured messaging, credible authority, and participatory channels can support the effective integration of tools like ChemDraw. The findings show that successful adoption

depends not only on technological infrastructure but also on communication strategies that legitimize innovation, foster confidence, and embed digital literacy within institutional culture. Ultimately, the research extends classical communication theory into the realm of vocational science education, offering a framework that strengthens chemical computing literacy and prepares students for a digitally empowered future.

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Effectiveness of a Psychotherapy-Based Emotional Regulation Intervention in Children with Autism Spectrum Disorder and Learning Disabilities: An Intervention Study

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Abstract

Children with Autism Spectrum Disorder (ASD) and learning disabilities often experience difficulties in emotional regulation, affecting their behaviour, social interactions, and academic functioning. This intervention study examined the effectiveness of a psychotherapy-based emotional regulation program for children aged 6–12 years with ASD and learning disabilities. The 12-week intervention incorporated cognitive-behavioural strategies, play therapy, emotional awareness activities, mindfulness techniques, and parent-supported emotional coaching. Pre- and post-intervention assessments indicated improvements in emotional recognition, self-regulation, coping skills, and social participation, along with reductions in emotional outbursts and anxiety-related behaviours. Findings suggest that psychotherapy-based emotional regulation interventions can positively support the psychological and developmental well-being of children with ASD and learning disabilities, highlighting the importance of integrated therapeutic, family, and school-based support.

Keywords: Autism Spectrum Disorder (ASD), Behavioural Intervention, Cognitive Behavioural Therapy (CBT), Child Mental Health, Emotional Regulation, Emotional Development, Learning Disabilities, Psychotherapy, Play Therapy, Psychological Well-being

Introduction

Children with neurodevelopmental conditions such as Autism Spectrum Disorder (ASD) and learning disabilities often experience persistent challenges in emotional regulation, social communication, and adaptive behaviour. Difficulties in identifying, expressing, and managing emotions can lead to heightened frustration, anxiety, behavioural outbursts, and withdrawal from social and academic environments. These challenges not only impact the child's psychological well-being but also place considerable stress on families and educational systems. Emotional regulation is a foundational skill that supports a child's ability to respond appropriately to environmental demands, engage in learning, and build meaningful relationships. In children with ASD and learning disabilities, deficits in cognitive flexibility, sensory processing, and executive functioning often interfere with the development of effective emotional control strategies. As a result, there is a growing need for structured therapeutic interventions that target both emotional awareness and behavioural regulation.

Psychotherapy-based approaches, including cognitive-behavioural therapy, play therapy, and mindfulness- based interventions, have shown promise in enhancing emotional and behavioural outcomes in children with developmental challenges. These approaches provide structured yet flexible frameworks that help children recognize emotions, develop coping strategies, and improve self-regulation skills in a supportive environment.

Given the increasing prevalence of ASD and learning disabilities globally, there is a critical need to explore integrated intervention models that combine psychological therapy with family and educational support. This study focuses on evaluating the effectiveness of a psychotherapy-based emotional regulation intervention designed to improve emotional competence, reduce behavioural difficulties, and enhance overall psychological well-being in children with ASD and learning disabilities.

Review of Related Literature

Emotional regulation is a significant challenge for children with Autism Spectrum Disorder (ASD), often affecting their social interactions, behaviour, and academic performance. Mazefsky et al. (2012) emphasized that difficulties in managing emotions are a core concern among individuals with ASD and highlighted the need for targeted interventions to improve emotional functioning. The World Health Organization (2023) also recognizes social and behavioural challenges as key characteristics of ASD, underscoring the importance of supportive therapeutic approaches.

Cognitive Behavioural Therapy (CBT) has been widely used to enhance emotional regulation and coping skills in children. Beck (2011) described CBT as an effective approach for identifying and modifying maladaptive thoughts and behaviours. Similarly, Sukhodolsky et al. (2004) reported that CBT-based interventions significantly reduce anger and emotional dysregulation in children and adolescents.

Play therapy and mindfulness-based interventions have also demonstrated positive outcomes in improving emotional awareness and self-control. Greenberg and Harris (2012) found that mindfulness practices promote self-regulation and emotional resilience among children. Furthermore, family involvement plays a crucial role in emotional development. Morris et al. (2007) noted that parental support and emotional coaching contribute significantly to the development of healthy emotional regulation skills. Studies by Koegel and Koegel (2006) and Weiss and Harris (2001) further suggest that integrated therapeutic and social-skills interventions can improve communication, social participation, and overall well-being in children with ASD and learning disabilities.

Objectives

The primary objective of this study was to evaluate the effectiveness of a psychotherapy-based emotional regulation intervention for children aged 6–12 years with Autism Spectrum Disorder (ASD) and learning disabilities. Specifically, the study aimed to examine whether a 12-week intervention incorporating cognitive-behavioural strategies, play therapy, emotional awareness activities, mindfulness techniques, and parent-supported emotional coaching could improve emotional recognition, emotional awareness, and self-regulation skills among participants. Additionally, the study sought to assess changes in coping abilities, social participation, and adaptive behavioural functioning following the intervention. Another important objective was to determine the extent to which the program could reduce emotional outbursts, anxiety-related behaviours, frustration, and other emotional and behavioural difficulties commonly

experienced by children with ASD and learning disabilities. Furthermore, the study aimed to explore the value of integrating therapeutic, family, and educational support systems in promoting emotional competence, psychological well-being, and overall developmental outcomes in this population.

Methodology

Study Design

This study adopted a quasi-experimental pre-test and post-test intervention design to evaluate the effectiveness of a psychotherapy-based emotional regulation program for children diagnosed with Autism Spectrum Disorder and learning disabilities. The intervention focused on improving emotional awareness, self-regulation, and adaptive coping skills through structured therapeutic techniques.

Participants

The study included children aged 6–12 years diagnosed with ASD and co-occurring learning disabilities, identified through clinical assessment and school records. Participants were selected using purposive sampling. Informed consent was obtained from parents or guardians prior to participation.

Intervention Procedure

The intervention was conducted over 12 weeks, with two sessions per week, each lasting 45–60 minutes. The psychotherapy-based program integrated cognitive-behavioural strategies, play therapy techniques, mindfulness exercises, emotional identification activities, and parent-assisted coaching. Sessions were structured to gradually enhance emotional recognition, expression, and regulation skills.

Tools and Measures

Standardized assessment tools were used to measure emotional regulation, behavioural difficulties, and social functioning before and after the intervention. Teacher and parent rating scales were also used to capture behavioural changes in natural settings.

Data Collection

Pre-intervention data were collected one week before the program began, and post-intervention data were collected immediately after completion of the 12-week intervention period. Consistent procedures were followed to ensure reliability and validity.

Data Analysis

Data were analysed using descriptive statistics and paired sample comparisons to assess differences between pre- and post-intervention scores. The level of significance was considered at $p < 0.05$. The analysis focused on changes in emotional regulation, behavioural outcomes, and social adaptability following the intervention.

Findings and Discussion

The findings of the study indicated notable improvements in emotional and behavioural functioning following the psychotherapy-based intervention. Post-intervention assessments showed significant enhancement in emotional recognition, emotional expression, and self-regulation skills among children with Autism Spectrum Disorder and learning disabilities. Children demonstrated a reduction in frequency and intensity of

emotional outbursts, anxiety-related behaviours, and frustration responses. Improvements were also observed in attention span, classroom participation, and peer interaction. Parent and teacher rating scales reflected consistent positive behavioural changes across home and school environments.

Quantitative analysis using paired comparisons revealed statistically significant differences between pre-test and post-test scores in emotional regulation and adaptive behaviour domains ($p < 0.05$), indicating the effectiveness of the intervention program. The results support the effectiveness of psychotherapy-based approaches in improving emotional regulation among children with neurodevelopmental challenges. The integration of cognitive- behavioural strategies, play-based techniques, mindfulness practices, and parental involvement appears to have contributed to improved emotional awareness and coping abilities. Children with ASD and learning disabilities often struggle with cognitive rigidity and sensory sensitivities, which can impair emotional control. The structured yet flexible nature of the intervention helped participants gradually build emotional understanding and develop appropriate behavioural responses.

The involvement of parents and teachers played a crucial role in reinforcing learned skills across different environments, ensuring better generalization of emotional regulation strategies. These findings are consistent with existing literature emphasizing the importance of multimodal, individualized interventions for neurodevelopmental disorders.

Overall, the study highlights that psychotherapy-based emotional regulation interventions can significantly enhance psychological well-being, social functioning, and adaptive behaviour in children with ASD and learning disabilities, supporting the need for early and integrated therapeutic approaches.

Roles and Themes

Emotional Awareness and Identification

Role: Helps children recognize and label their own emotions (e.g., happy, sad, angry, anxious) using structured activities such as emotion cards, storytelling, and visual cues.
Theme focus: Building basic emotional vocabulary and self-awareness as the foundation of emotional regulation.

Emotional Expression and Communication

Role: Encourages children to express emotions appropriately through speech, play, drawing, and role-play activities.
Theme focus: Reducing emotional suppression and improving communication of internal feelings in socially acceptable ways.

Self-Regulation and Coping Strategies

Role: Teaches children practical techniques such as deep breathing, counting, mindfulness exercises, and relaxation strategies to manage emotional intensity.
Theme focus: Developing control over impulsive reactions and improving stress tolerance.

Behavioural Modification and Positive Reinforcement

Role: Uses structured reinforcement systems to encourage desirable behaviours and reduce maladaptive responses such as aggression or tantrums.
Theme focus: Strengthening adaptive behavioural patterns through consistent feedback and rewards.

Social Skills and Peer Interaction
Role: Enhances skills such as turn-taking, sharing, eye contact, and cooperative play through group activities and guided interactions.
Theme focus: Improving social integration and reducing isolation in children with Autism Spectrum Disorder and learning disabilities.

Parent and Teacher Involvement
Role: Involves caregivers in therapy sessions and provides training for reinforcement of emotional regulation strategies at home and school.
Theme focus: Ensuring consistency, generalization of skills, and long-term sustainability of intervention outcomes.

Cognitive Restructuring and Problem-Solving
Role: Helps children identify simple thought patterns and alternative responses to challenging situations using guided psychotherapy techniques.
Theme focus: Improving flexible thinking and reducing rigid or negative emotional responses.

Conclusion

The present intervention study demonstrates that psychotherapy-based emotional regulation programs can be highly effective in improving emotional, behavioural, and social functioning in children with Autism Spectrum Disorder and learning disabilities. The integration of cognitive-behavioural techniques, play therapy, and mindfulness practices, and structured emotional skill training contributed to meaningful improvements in emotional awareness, self-regulation, and coping abilities.

Findings from the study indicate a reduction in emotional outbursts, anxiety-related behaviours, and maladaptive responses, along with improved social interaction and classroom participation. The involvement of parents and teachers further strengthened the effectiveness of the intervention by ensuring consistency and reinforcement across home and school environments. Overall, the study highlights the importance of early, structured, and holistic psychotherapeutic interventions in addressing emotional regulation difficulties in neurodevelopmental conditions. Such approaches not only enhance psychological well-being but also support academic engagement and social development.

Future research should focus on larger sample sizes, randomized controlled trials, and long-term follow- up studies to validate and expand the effectiveness of psychotherapy-based emotional regulation interventions across diverse clinical and educational settings.

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