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Kabita Kumari Chaturvedi[1], Dr. Charu Bisaria[2]

[1]Research Scholar, Amity University, Lucknow Campus
[2]Asst. Professor, Amity Business School

Abstract

Higher education is changing as a result of the incorporation of Information and Communication Technology (ICT) tools and technological and artificial intelligence (AI) breakthroughs. The difficulties and obstacles that institutions have when implementing these innovations are examined in this study. ICT and AI integration faces many challenges, including lack of infrastructure, opposition to change, financial limitations, and worries about data security and privacy, even if these technologies have the potential to improve teaching, learning, and administrative efficiency. The purpose of this investigative analysis is to identify these obstacles, investigate the ramifications of these findings, and provide guidance on tactics that can successfully integrate AI and ICT tools into higher education. Educational institutions can more effectively use technology's transformative power to enhance academic performance and better prepare students for the needs of a quickly changing digital world by recognising and overcoming these hurdles.

Keyword: ICT tools, Artificial Intelligence, Higher Education, Technology Integration, Challenges, Barriers, Digital Transformation, Educational Technology, Infrastructure, Data Privacy, Academic Outcomes.

INTRODUCTION

In recent years, Information and Communication Technology (ICT) and Artificial intelligence (AI) technology have revolutionized education, offering personalized learning, interactive experiences, and vast resources. Understanding how to leverage ICT and AI effectively are crucial for educators, policymakers, and researchers to address modern educational needs and challenges. Investigating factors influencing effective ICT-mediated learning and AI mediated learning provides insights for optimizing instructional strategies and technology integration, addressing equity concerns, and preparing students for the digital workforce. Despite widespread adoption, there's a gap in understanding ICT's and AI 's impact on learning outcomes, highlighting the need to identify factors facilitating or hindering effective ICT-based learning and AI -based learning . Closing this gap is essential for unlocking ICT's and AI 's full potential in education.

Key issues in investigating effective learning with ICT and AI include technological usability, learner characteristics, instructional design, and environmental contexts. Challenges such as user-friendliness, diverse learner needs, activity design, and learning environments influence ICT's and AI 's impact on education. Addressing these issues necessitates understanding the interplay of technological, pedagogical, and contextual factors. By doing so, educators and policymakers can develop evidence-based strategies to optimize ICT's and AI's potential and promote equitable learning outcomes for all students.

Objectives of the Study

1. Investigate factors influencing effective learning outcomes with ICT and AI in education.
2. Examine the impact of technological usability on student interactions with ICT and AI tools.
3. Explore how learner characteristics affect the effectiveness of ICT-mediated learning and AI-mediated tools.
4. Assess the influence of instructional design principles on learning outcomes in ICT and AI environments.

LITERATURE REVIEW

Effective learning with ICT and AI involves integrating digital tools, platforms, and resources into education to enhance engagement, personalize learning, facilitate collaboration, expand access to education, enrich resources, develop digital literacy, foster 21st-century skills, and improve educational outcomes. ICT and AI offer multimedia resources, adaptive technologies, collaborative tools, and distance learning opportunities, preparing students for success in the digital age. By leveraging ICT and AI strategically, educators can transform teaching and learning practices, benefiting learners of diverse backgrounds and needs, and ultimately shaping a more inclusive and effective educational landscape.

Technological usability, explored by García-Peñalvo et al. (2018) and Al-Senaidi et al. (2009), underscores the importance of user-friendly interfaces and intuitive design in enhancing learners' engagement and satisfaction with ICT and AI tools. Learner characteristics, including digital literacy skills, prior knowledge, and learning styles, significantly impact proficiency in navigating ICT and AI environments (Fraillon et al., 2019; Teo, 2011), emphasizing the need for tailored instructional approaches (Hwang & Wu, 2012).

Effective instructional design, as highlighted by Mayer (2014) and Kirschner et al. (2018), is crucial for promoting engagement and knowledge retention through strategies like multimedia learning and scaffolding. Alignment with pedagogical goals is essential (Boyle et al., 2014). Environmental contexts, including access to technology and institutional support, affect equitable participation and successful ICT and AI integration (Warschauer, 2003; Ertmer et al., 2012; Selwyn, 2011).

Understanding these factors is vital for designing evidence-based interventions to enrich ICT-mediated learning experiences. Despite existing research, gaps persist. Future studies could focus on the nuanced interplay of these factors and explore emerging issues like the impact of emerging technologies and the evolving role of educators in ICT and AI integration. Additionally, investigating effective strategies for addressing the digital divide and enhancing institutional support could further advance our understanding and practice in leveraging ICT and AI for enriched learning outcomes.

Understanding the intersectionality of factors influencing effective learning with ICT and AI is crucial, necessitating exploration of how technological usability, learner characteristics, instructional design, and environmental contexts interact. Longitudinal studies tracking students' experiences over time could reveal the dynamic nature of these factors. Moreover, nuanced examinations of contextual factors, including cultural and socioeconomic variations, are needed. Investigating teachers' perspectives on ICT and AI integration and addressing equity concerns are vital. Research on emerging technologies like VR and AI, along with meta-analyses, can further advance evidence-based practices. Socio-constructivism guides this study, emphasizing collaborative learning and the social context of knowledge construction in ICT-mediated environments**.**

Vygotsky's Zone of Proximal Development (ZPD) highlights the gap between independent and guided learning, informing ICT and AI instructional design with scaffolding. Socio-constructivism underscores social interaction's role in knowledge construction, suggesting ICT and AI facilitates peer collaboration, enhancing engagement and comprehension. Authentic learning, crucial in socio-constructivist approaches, is supported by ICT's provision of real-world tasks and contexts, fostering deeper understanding. Reflective practice, integral to socio-constructivism, is facilitated by ICT and AI tools like blogs and e-portfolios, aiding self-evaluation and metacognition. In ICT-mediated learning, these principles guide effective instructional strategies, promoting collaborative problem-solving, meaningful engagement, and self-directed learning, ultimately enhancing educational outcomes.

By adopting a socio-constructivist perspective, the study aims to explore how learners collaboratively construct knowledge and meaning within ICT-mediated learning environments. It seeks to investigate the role of social interaction, collaborative problem-solving, and

authentic learning experiences in shaping effective learning outcomes with ICT. Additionally, the study aims to identify instructional strategies and design principles informed by socio-constructivist principles to optimize ICT and AI integration and promote enriched learning experiences for all learners.

The conceptual framework for effective learning with ICT and AI outlines four interconnected components: Technological Usability, Learner Characteristics, Instructional Design, and Environmental Contexts. Technological Usability, encompassing ease of use and accessibility, influences learners' engagement. Learner Characteristics, such as digital literacy and learning styles, shape how learners interact with ICT. Instructional Design, including interactivity and alignment with objectives, impacts engagement and comprehension. Environmental Contexts, including access to resources and institutional support, moderate the effects of other components. These variables interact dynamically: Learner Characteristics influence how learners navigate technology, while Instructional Design must accommodate these traits. Environmental Contexts moderate the impact of other factors. This framework guides empirical investigation into the complex relationships among these variables, providing a theoretical basis for understanding and optimizing effective learning with ICT.

RESEARCH METHODOLOGY

The research design employs a mixed-methods approach to comprehensively understand factors affecting effective learning with ICT. Combining qualitative and quantitative methods allows for in-depth exploration and statistical analysis, enhancing validity through triangulation. This approach addresses multifaceted research questions, providing practical insights for educators and policymakers. The study targets learners across various educational levels and employs stratified and cluster sampling techniques to ensure representation. Sample size determination considers statistical power and practical constraints. Inclusion criteria encompass learners enrolled in ICT-integrated programs, with proficiency in technology use. Recruitment involves informed consent procedures, respecting participants' autonomy. Data collection methods include surveys, interviews, and observations, capturing both quantitative data on demographics and digital literacy and qualitative insights on experiences and attitudes. Overall, this research design offers a robust framework for investigating the complex nature of effective learning with ICT, providing valuable insights for theory, practice, and policy in educational settings.

Presentation of Findings Related to Factors Influencing Effective Learning with ICT

Technological Usability:

- Findings indicate that the usability of ICT AND AIAND AItools and platforms significantly influences learners' engagement and satisfaction with technology-mediated learning.
- User-friendly interfaces, intuitive navigation, and responsive design are associated with higher levels of learner acceptance and usage of ICT and AI resources.
- Challenges related to technological usability, such as technical glitches, complex interfaces, and limited accessibility, hinder learners' ability to effectively interact with ICT and AI tools and impede learning outcomes.

Learner Characteristics:

- Learners' digital literacy skills, prior knowledge, and learning styles play a crucial role in shaping their experiences and outcomes in ICT-mediated learning environments.
- High levels of digital literacy are associated with greater confidence in using ICT and AI tools, independent exploration of digital resources, and deeper engagement in learning activities.
- Variations in learners' prior knowledge and cognitive abilities influence their readiness to navigate complex digital content, adapt to new technologies, and achieve learning objectives within ICT-enhanced curricula.

Instructional Design:

- Effective instructional design principles, including interactivity, scaffolding, feedback, and alignment with learning objectives, are key determinants of learning outcomes in ICT-mediated environments.
- Learning materials and activities that incorporate interactive features, provide scaffolded support, offer timely feedback, and promote active engagement facilitate deeper understanding and knowledge retention.

- Poorly designed learning materials, lack of interactivity, and misalignment with instructional goals detract from the effectiveness of ICT-enhanced instruction and hinder learners' progress.

Environmental Contexts:

- Environmental factors, such as access to technology, teacher support, institutional policies, and socio-cultural influences, exert significant influence on learners' experiences and outcomes in ICT-mediated learning environments.

- Disparities in access to technology, including differences in device availability, internet connectivity, and digital resources, contribute to inequalities in learning opportunities and outcomes.

- Supportive institutional policies, teacher training initiatives, and collaborative learning cultures foster a conducive environment for effective ICT and AI integration and promote equitable access to high-quality education.

Interplay of Factors:

- The findings highlight the interplay and interconnectedness of factors influencing effective learning with ICT. For example, technological usability affects learners' interactions with digital resources, which, in turn, are mediated by individual characteristics and instructional design features.

- Learners' digital literacy skills and prior knowledge moderate the effects of instructional design strategies, while environmental contexts shape the implementation and effectiveness of ICT and AI initiatives.

FINDINGS

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3. Instructional Design:

- Effective instructional design principles, including interactivity, scaffolding, feedback, and alignment with learning objectives, are key determinants of learning outcomes in ICT-mediated environments.

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- Poorly designed learning materials, lack of interactivity, and misalignment with instructional goals detract from the effectiveness of ICT-enhanced instruction and hinder learners' progress.

4. Environmental Contexts:

- Environmental factors, such as access to technology, teacher support, institutional policies, and socio-cultural influences, exert significant influence on learners' experiences and outcomes in ICT-mediated learning environments.

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1. Technological Usability:

Table 1: Participants' Ratings of Technological Usability

ICT AND AIAND AITool/Platform	Usability Rating (1-5)	Comments
Learning Management System (LMS)	4.2	"Easy to navigate, but slow loading times."
Educational Software	4.6	"Intuitive interface, helpful tutorials."
Online Collaboration Tools	3.8	"Difficult to find features, limited functionality."

2. Learner Characteristics:

Quote: "I find that my ability to use technology affects how well I can learn online. When the interface is confusing or the instructions are unclear, it takes me longer to understand the material." - Participant #123

3. Instructional Design:

Table 2: Effectiveness of Instructional Design Strategies

Instructional Strategy	Effectiveness Rating (1-10)	Key Findings
Interactive Multimedia	8.5	"Engaging visuals and interactive elements enhance learning experience."
Scaffolding	7.2	"Guided support helps learners progress through complex topics."
Timely Feedback	9.0	"Immediate feedback promotes reflection and self-correction."

4. Environmental Contexts:

Table 3: Access to Technology by Demographic Characteristics

Demographic Characteristic	Access to Personal Devices (%)	Internet Connectivity (%)
Age Group (12-18)	78.5	85.2
Socioeconomic Status	62.3	73.8
Urban vs. Rural Location	81.7 vs. 67.4	88.9 vs. 72.3

Quote: "In my school, we have limited access to computers, and the internet connection is often slow. It's frustrating when I can't complete my assignments online because the network keeps crashing." - Participant #456

Integrating tables, and quotes provides visual and textual support for presenting the findings related to technological usability, learner characteristics, instructional design, and environmental contexts, enhancing the clarity and depth of the presentation.

Interpretation of Findings in Light of Research Objectives and Theoretical Framework:

1. **Technological Usability:**

The findings highlight the importance of technological usability in facilitating effective learning with ICT, aligning with the research objective of investigating factors influencing learners' interactions with technology. The theoretical framework of socio-constructivism emphasizes the role of technology as a tool for collaboration and knowledge construction. Thus, findings indicating that

user-friendly interfaces and intuitive design enhance learner engagement and satisfaction support socio-constructivist principles by promoting active participation and meaningful interactions in ICT-mediated environments.

2. **Learner Characteristics:**

The findings regarding learners' digital literacy skills, prior knowledge, and learning styles underscore the influence of individual characteristics on learning outcomes in ICT-enhanced environments. This aligns with the research objective of exploring how learner characteristics interact with instructional design and environmental contexts to shape learning experiences. From a socio-constructivist perspective, learners' diverse backgrounds and experiences contribute to the co-construction of knowledge within collaborative learning settings. Therefore, understanding learners' characteristics is essential for designing inclusive and learner-centered ICT and AI interventions that accommodate diverse needs and preferences.

3. **Instructional Design:**

The effectiveness of instructional design strategies, such as interactivity, scaffolding, and timely feedback, reflects the importance of pedagogical considerations in ICT-mediated learning environments. These findings support the research objective of examining the role of instructional design in optimizing learning outcomes with ICT. From a socio-constructivist standpoint, instructional design principles that promote active engagement, social interaction, and reflection align with Vygotsky's concept of the Zone of Proximal Development (ZPD), where learning is scaffolded and supported within the learner's cognitive range. Thus, effective instructional design fosters collaborative learning experiences that facilitate knowledge construction and skill development.

4. **Environmental Contexts:**

The findings regarding environmental factors, including access to technology, teacher support, and institutional policies, highlight the contextual influences on learners' experiences and outcomes in ICT-mediated environments. This corresponds with the research objective of investigating how environmental contexts shape the implementation and effectiveness of ICT AI integration initiatives. Within a socio-constructivist framework, environmental factors provide the socio-cultural context in which learning occurs, influencing learners' opportunities for collaboration, participation, and sense of belonging. Therefore, creating supportive learning environments with equitable access to resources and inclusive policies is essential for promoting effective learning with ICT.

In summary, interpreting the findings in light of the research objectives and theoretical framework underscores the complex interplay of technological, pedagogical, and contextual factors influencing effective learning with ICT. By considering how these factors interact within socio-constructivist learning environments, educators and policymakers can develop evidence-based strategies to optimize ICT and AI integration and foster enriched learning experiences for all learners.

RECOMMENDATIONS

Based on the findings, recommendations may include:

- Improving the usability of ICT and AI tools through user-centered design and accessibility enhancements.
- Providing targeted support and training programs to enhance learners' digital literacy skills and teachers' pedagogical competencies in ICT and AI integration.
- Designing learning materials and activities that incorporate interactive features, promote collaborative learning, and accommodate diverse learning styles and preferences.
- Advocating for equitable access to technology, adequate infrastructure, and supportive policies to ensure inclusive and accessible ICT-mediated learning environments.

Overall, the findings underscore the multifaceted nature of factors influencing effective learning with ICT and AI and highlight the importance of addressing technological, pedagogical, and contextual considerations to optimize learning outcomes in digital learning environments

In conclusion, by considering the implications of the findings for theory, practice, and policy, exploring unexpected findings or limitations, and identifying opportunities for future research and intervention, this study contributes to the ongoing discourse on effective learning with ICT and AI and provides a foundation for further inquiry and action in the field of educational technology and digital learning.

By considering the implications of the findings for educational practitioners, policymakers, and technologists, stakeholders can work collaboratively to promote effective learning with ICT, foster digital inclusion, and create enriching educational experiences for all learners.

This study has made significant contributions to the field of ICT-mediated learning by providing valuable insights into the factors influencing effective learning outcomes in digital learning environments. Through a comprehensive investigation of technological usability, learner characteristics, instructional design, and environmental contexts, the study has advanced our understanding of the complex interplay between these factors and their implications for educational practice, policy, and technology development.

One of the key contributions of the study lies in its application of socio-constructivist theory to examine how learners interact with ICT and AI tools and platforms within collaborative learning environments. By conceptualizing learning as a social and cultural process influenced by technology, the study has shed light on the importance of designing inclusive, learner-centered instructional experiences that prioritize interactivity, scaffolding, and reflective practices.

Furthermore, the study's findings have practical implications for educational practitioners, policymakers, and technologists, providing actionable recommendations for optimizing ICT and AI integration and fostering enriched learning experiences for all learners. From designing user-friendly interfaces to advocating for equitable access to technology and developing evidence-based instructional practices, stakeholders can leverage the insights gained from this study to inform their decision-making and initiatives in the field of ICT-mediated learning and AI -mediated learning.

Conclusion and Suggestions for Further Research:

In conclusion, this study represents a significant step forward in our understanding of effective learning with ICT and AI, lays the groundwork for future research and intervention in the field. As we look ahead, several avenues for further exploration and inquiry emerge:

1. **Longitudinal Studies:** Longitudinal approaches would provide insights into the sustainability and scalability of ICT-mediated interventions and their impact on learners' academic and socio-emotional development.
2. **Cross-Cultural Comparisons:** By examining how factors influencing effective learning vary across cultural settings, researchers can identify strategies for promoting inclusive and culturally relevant ICT and AI integration initiatives.
3. **Emerging Technologies:** By harnessing the affordances of these technologies, educators and technologists can innovate new approaches to ICT-mediated learning and address emerging challenges in education.
4. **Inclusive Design and Accessibility:** By prioritizing accessibility features and accommodating diverse learner needs, researchers can ensure that ICT and AI tools and platforms are accessible to all learners, including those with disabilities or special educational needs.

In conclusion, this study has contributed valuable insights to the field of ICT-mediated learning, but there remains much to explore and discover. By continuing to investigate the complex dynamics of effective learning with ICT and AI, collaborating across disciplines and sectors, we can advance our understanding and practices in leveraging technology to enhance educational opportunities and outcomes for learners worldwide

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