

Technology-Integrated Teaching in Higher Education: An Empirical Study on AI-Supported Learning, Digital Tools, and LMS Innovations

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Abstract

Technology integration has become a cornerstone of innovation in higher education, driven by rapid advancements in artificial intelligence (AI), digital learning tools, and Learning Management Systems (LMS). This study examines how university students perceive and engage with technology-integrated teaching practices, especially AI-supported learning, digital tools, and LMS innovations. Using a quantitative survey-based methodology, data were collected from 320 undergraduate and postgraduate students at a Sri Lankan university offering blended and distance-learning programs. The study aimed to (a) measure students' perceived usefulness of AI-supported learning tools, (b) assess their satisfaction with technology-integrated teaching, and (c) examine the relationship between AI usage, LMS engagement, and learning outcomes.

A validated 38-item questionnaire measured four constructs: AI-Supported Learning, Digital Tool Use, LMS Engagement, and Perceived Learning Outcomes. Results indicate that students strongly support the integration of AI tools—such as automated feedback systems, intelligent tutoring interfaces, and generative AI chatbots—into teaching practices. Reliability analyses showed strong internal consistency (Cronbach's alpha = .87–.93). Correlation and regression analyses reveal that AI-Supported Learning significantly predicts Perceived Learning Outcomes ($\beta = .41, p < .001$), while LMS Engagement ($\beta = .36, p < .001$) and Digital Tool Use ($\beta = .29, p < .01$) also contribute positively.

The findings highlight the growing relevance of adaptive, AI-enhanced ecosystems in higher education. The study recommends professional development for academic staff, structured policies on AI integration, and continuous enhancement of LMS design to maximize student engagement, autonomy, and academic performance.

Keywords: AI-supported learning; digital tools; higher education; technology-integrated teaching; student engagement

1. Introduction

Over the past decade, technological innovation has dramatically reshaped the landscape of higher education, with artificial intelligence, digital tools, and LMS playing increasingly pivotal roles in pedagogical practices. The integration of such technologies is no longer optional; rather, it has become central to institutional strategies for enhancing instructional design, fostering student engagement, and supporting lifelong learning. This transformation became especially pronounced following the COVID-19 pandemic, which accelerated the shift toward blended and fully online learning models worldwide. For many universities, the adoption of AI-supported learning tools and advanced LMS functionalities not only ensured academic continuity

during the crisis but also introduced new pedagogical possibilities that were once largely theoretical.

In Sri Lanka, higher education institutions such as the Open University of Sri Lanka (OUSL), the University of Colombo, and other state universities have actively embraced digital transformation. Historically grounded in traditional face-to-face instruction, the sector rapidly expanded its digital infrastructure in response to pandemic-driven disruptions. Many universities strengthened their LMS platforms (e.g., Moodle, Canvas) to support multimedia content, online assessments, discussion forums, and analytics dashboards. Concurrently, AI-driven applications—such as automated grading systems, intelligent tutoring systems, and conversational support agents—became more common in teaching and assessment practices. These innovations represent more than technological upgrades; they

constitute a fundamental shift in how educational content is structured, delivered, and evaluated.

Despite widespread enthusiasm, effective use of AI tools and LMS innovations depends on thoughtful pedagogical integration. AI-supported learning tools hold substantial promise by enabling personalized learning experiences, data-informed feedback, and adaptive learning pathways. For example, adaptive quizzes respond to learners' performance levels, while intelligent tutoring systems scaffold learners through complex concepts. Generative AI platforms, including chat-based assistants, facilitate explanation, summarization, and clarification, promoting metacognitive awareness and deeper conceptual understanding (Holmes, Bialik, & Fadel, 2022). Digital tools—such as simulations, multimedia resources, virtual whiteboards, and cloud-based collaboration platforms—further enrich the learning environment by promoting inquiry-based and constructivist learning approaches serve as the central infrastructure for integrating AI tools and digital resources into a unified learning ecosystem. Modern LMS platforms provide real-time analytics, progress tracking, mobile accessibility, and gamified learning elements. These capabilities allow instructors to monitor student engagement and provide timely interventions, while enabling students to visualize their own learning progress and receive automated feedback. LMS innovations, therefore, function as the nexus where AI-supported learning and digital tools converge (Ifenthaler & Yau, 2020).

However, despite the rapid expansion of digital technologies in Sri Lankan universities, a critical research gap persists. Few empirical studies have examined how students perceive AI-supported learning, how frequently and effectively digital tools are used, or how LMS innovations shape learning outcomes. While anecdotal evidence and institutional reports indicate positive trends, comprehensive data on learners' attitudes, acceptance, and behavioral engagement remains limited.

Addressing this gap is crucial for informing effective digital pedagogy. First, understanding student perceptions can guide improvements in instructional design. Second, identifying key predictors of learning outcomes can support targeted investment in LMS features, faculty development, and AI tool deployment. Third, analyzing student engagement patterns can strengthen the scalability of digital learning initiatives across disciplines.

Guided by the Technology Acceptance Model (TAM; Davis, 1989), the Unified Theory of Acceptance and Use of Technology (UTAUT; Venkatesh et al., 2003), and Constructivist Learning Theory (Piaget, 1976; Vygotsky, 1978), this study investigates how AI-supported learning tools, digital tool usage, and LMS engagement influence perceived learning outcomes in higher education. Accordingly, the study explores three research questions: (1) How do students perceive AI-supported learning tools? (2) What is the level of engagement with digital tools and LMS functionalities?

(3) How do these practices predict perceived learning outcomes?

Drawing on survey data from 320 students enrolled in blended or distance-learning programs, this study contributes to the expanding body of literature on digital pedagogy in higher education. The findings offer actionable insights for educators, instructional designers, and policymakers, particularly within the Sri Lankan context, where digital learning initiatives continue to evolve. Ultimately, this research highlights the transformative potential of technology-integrated teaching in creating adaptive, engaging, and effective learning environments.

1.1 Research Problem

Although Sri Lankan universities have made significant progress in digital transformation, limited empirical evidence exists on how AI-supported learning tools and LMS innovations impact student learning outcomes. Current literature does not sufficiently address students' perceptions, acceptance, and engagement with these digital technologies.

1.2 Research Objectives

1. To assess students' perceptions of AI-supported learning tools in higher education.
2. To examine students' engagement with digital tools and LMS innovations.
3. To evaluate the relationship between technology-integrated teaching practices and perceived learning outcomes.
4. To propose recommendations for enhancing technology-integrated teaching in Sri Lankan universities.

1.3 Research Questions

1. How do higher education students perceive AI-supported learning?
2. What is the level of engagement with digital tools and LMS features?
3. How do AI-supported learning, digital tool use, and LMS engagement predict learning outcome.

2. Literature Review

The existing body of literature consistently highlights the transformative impact of AI-driven and LMS-supported learning environments on student engagement, motivation, and academic performance. AI-enhanced learning platforms provide personalized instructional pathways through adaptive learning algorithms, automated feedback mechanisms, and intelligent tutoring systems that dynamically respond to students' needs (Luckin et al., 2021; Holmes et al., 2022). These systems promote self-regulation and metacognitive development by helping students identify misconceptions

and adjust learning strategies accordingly. When combined with digital tools such as multimedia resources, virtual labs, and cloud-based collaborative applications, technology-enabled environments support deeper learning through multimodal engagement, synchronous and asynchronous interactions, and opportunities for co-construction of knowledge.

LMS serve as a central hub for integrating digital tools and AI-supported features. Well-designed LMS functionalities—such as analytics dashboards, discussion forums, progress trackers, and interactive modules—correlate positively with academic engagement and satisfaction (Ifenthaler & Yau, 2020). However, limitations such as poor instructional design, low digital literacy, and inadequate institutional support can hinder adoption. Studies from developing countries show that students often rely on mobile phones to access LMS platforms, underscoring the importance of intuitive interfaces and mobile optimization.

Globally, technology-enhanced learning environments have shifted higher education toward more student-centered, flexible, and data-informed pedagogies (Hattie & Donoghue, 2016; Bates, 2022). AI systems have expanded these shifts by offering predictive analytics, conversational support, automated grading, and generative capabilities that facilitate active and personalized learning. Research demonstrates that intelligent tutoring systems and adaptive quizzes enhance cognitive processing by adjusting content complexity, while generative AI tools—such as chatbots and writing assistants—support higher-order thinking through explanation, summarization, and guided inquiry (VanLehn, 2011; Miao, Holmes, & Yu, 2021). These tools are particularly valuable in large-class settings where individualized instructor support is limited (Chatterjee, Rana, & Dwivedi, 2021).

Digital tools complement AI-enabled systems by enabling collaborative, multimodal, and accessible learning experiences. Multimedia platforms, simulations, and cloud-based applications promote constructivist learning by allowing students to explore content interactively, participate in problem-based activities, and engage in peer collaboration (Huang et al., 2020). The flexibility offered by these tools enhances accessibility, accommodating learners with different preferences and technological constraints.

LMS platforms remain foundational to these technological ecosystems. Platforms such as Moodle, Blackboard, and Canvas integrate assessments, communication channels, analytics, and content delivery in a unified structure (Ifenthaler & Yau, 2020). Engagement with LMS features has been strongly associated with academic achievement, motivation, and persistence (Al-Fraihat et al., 2020). Advanced features like learning analytics allow instructors to identify at-risk students, support timely interventions, and optimize course delivery. Gamified LMS components and adaptive learning modules further promote sustained engagement (Shen, Wang, & Shen, 2009).

Despite these benefits, successful implementation requires appropriate pedagogical design, faculty training, student digital readiness, and attention to ethical considerations. Adoption of technology is influenced by perceived usefulness, ease of use, self-efficacy, and institutional support (Venkatesh, Thong, & Xu, 2016). Concerns related to data privacy, algorithmic bias, and transparency remain significant barriers to widespread AI adoption (Holmes et al., 2022). Thus, empirical research must examine not only the effectiveness of these technologies but also contextual factors that determine successful adoption.

In Sri Lanka, institutions such as the Open University of Sri Lanka have taken significant steps to integrate AI-supported learning tools and LMS-driven instruction (Fernando & Jayasinghe, 2021). However, empirical research on student perceptions, engagement, and learning outcomes remains sparse. Existing studies highlight benefits such as flexibility and personalized learning but also identify challenges, including unstable internet connectivity, limited digital proficiency, and insufficient instructor support (Perera, 2020). Given these contextual variables, more local research is required to evaluate how students perceive and engage with technology in blended and distance-learning models.

Overall, the literature underscores the potential of AI-supported learning tools, digital resources, and LMS innovations to enhance engagement, personalize learning, and improve academic outcomes. However, successful implementation hinges on thoughtful integration aligned with pedagogical goals, technological readiness, and ethical standards. This study contributes to filling this gap by examining how Sri Lankan university students perceive and engage with technology-integrated learning environments.

2.1.1 Technology Integration in Higher Education

Technology integration refers to the purposeful use of digital tools to enhance teaching and learning (Harris & Hofer, 2020). Higher education institutions are increasingly shifting toward technology-rich environments characterized by blended learning, flipped classrooms, and collaborative online platforms.

2.1.2 AI-Supported Learning

AI in education encompasses systems that provide personalized feedback, adaptive learning pathways, automated assessment, and conversational support (Luckin et al., 2021). Generative AI tools, such as chatbots and writing assistants, support clarification, summarization, and concept explanation.

2.1.3 Digital Tools for Learning

Digital learning tools include multimedia content, virtual laboratories, cloud-based applications, and collaborative platforms (Bates, 2022). Student proficiency with these tools strongly influences engagement and academic performance.

2.1.4 LMS

LMS platforms provide structured environments for delivering digital content, assessments, and analytics. LMS engagement is a consistent predictor of success in blended learning contexts (Ifenthaler & Yau, 2020).

2.1.5 Theoretical Frameworks

This study draws on the Technology Acceptance Model (TAM), Unified Theory of Acceptance and Use of Technology (UTAUT), and Constructivist Learning Theory to explain how students adopt, engage with, and benefit from technology-enhanced learning environments.

2.1.6 Research Design

A quantitative survey-based research design was adopted to investigate students' perceptions and engagement with AI-supported learning, digital tools, and LMS innovations. This design enables objective measurement of attitudes, behaviors, and learning outcomes across a large sample (Creswell & Creswell, 2018). Structured items measured AI-supported learning, digital tool use, LMS engagement, and perceived learning outcomes.

2.1.7 Population and Sample

The population comprised undergraduate and postgraduate students enrolled in blended and distance-learning programs. Stratified random sampling produced a representative sample of 320 students. Stratification ensured proportional representation across faculties, levels of study, and gender. The sample size aligns with Krejcie & Morgan's (1970) recommendations.

2.1.8 Instrumentation

A structured questionnaire measured four constructs using validated scales:

- **AI-Supported Learning (10 items)**
- **Digital Tool Use (8 items)**
- **LMS Engagement (10 items)**
- **Perceived Learning Outcomes (10 items)**

All items used a 5-point Likert scale. Items were adapted from validated studies (Al-Fraihat et al., 2020; Holmes et al., 2022).

2.1.9 Validity and Reliability

Content validity was ensured through expert review. A pilot test ($n = 30$) produced high Cronbach's alpha values (0.87–0.93). Exploratory factor analysis confirmed construct validity.

2.1.10 Data Collection Procedures

Data were collected over four weeks using an online survey. A total of 350 responses were received, with 320 usable responses (91% valid response rate).

2.1.11 Data Analysis Techniques

Data were analyzed in SPSS v27 using:

- Descriptive statistics
- Reliability analysis
- Correlation analysis
- Multiple regression analysis

Assumptions such as multicollinearity ($VIF < 5$) were checked.

2.1.12 Ethical Considerations

Ethical approval was obtained from the university's Research Ethics Committee. Participation was voluntary, anonymous, and based on informed consent.

2.1.13 Summary

This chapter presented a rigorous quantitative methodology supported by theoretical frameworks, ensuring reliable and valid analysis of how technology-integrated teaching practices influence student learning outcomes.

3. Results and Discussion

3.1.1 Sample Characteristics

A total of **320 students** participated in the study. Table 1 summarizes the demographic characteristics of the sample.

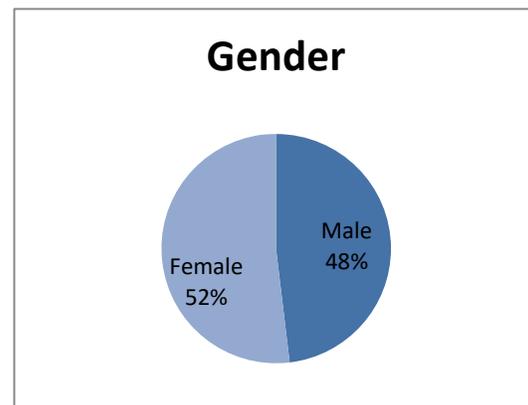


Fig 1. Gender Demographics

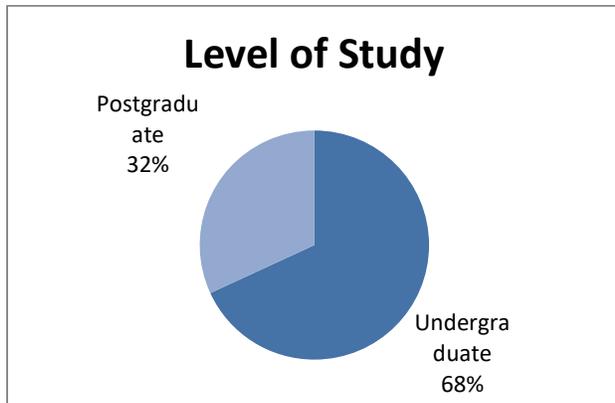


Fig 2. Level of Study Demographics

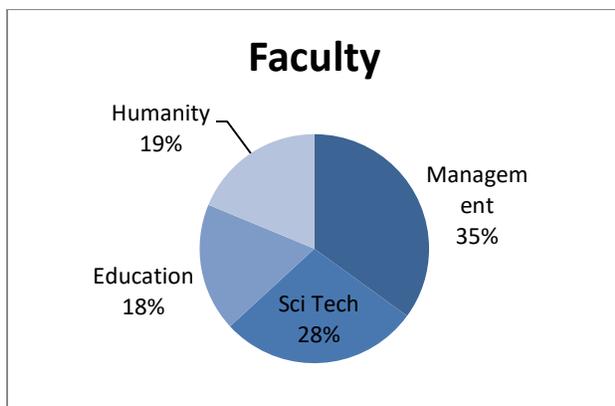


Fig 3. Faculty Demographics

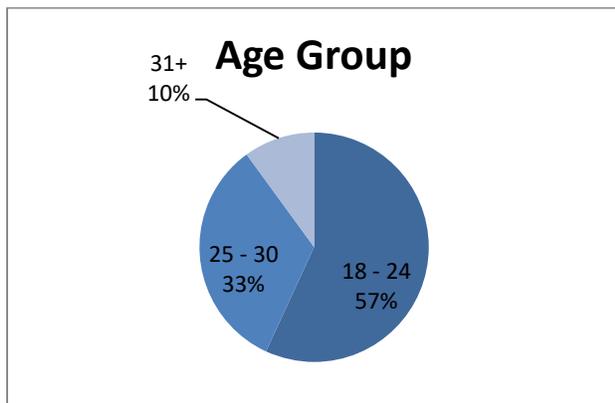


Fig 4. Age Group Demographics

The sample was well-distributed across gender, faculty, and levels of study, allowing for meaningful analysis of student perceptions and engagement across diverse contexts.

3.1.2 Descriptive Statistics of Constructs

Table 2 presents the descriptive statistics for the four key constructs: AI-Supported Learning, Digital Tool Use, LMS Engagement, and Perceived Learning Outcomes.

Table 1
Descriptive Statistics of Constructs

Construct	Mean (M)	Standard Deviation (SD)	Interpretation
AI-Supported Learning	4.23	0.56	High
Digital Tool Use	4.08	0.61	High
LMS Engagement	4.15	0.59	High
Perceived Learning Outcomes	4.19	0.58	High

The results indicate that students hold **positive perceptions** toward AI-supported learning tools and digital learning platforms, with mean scores above 4.0 on a 5-point scale. LMS engagement is also strong, suggesting that students actively interact with course materials and features provided through the learning management system.

3.1.3 Reliability Analysis

The internal consistency of each construct was assessed using **Cronbach’s alpha**.

Table 2.
Reliability Analysis (Cronbach’s Alpha)

Construct	Number of Items	Cronbach’s Alpha
AI-Supported Learning	10	0.92
Digital Tool Use	8	0.89
LMS Engagement	10	0.93
Perceived Learning Outcomes	10	0.87

All constructs demonstrated high reliability, exceeding the 0.70 threshold (Nunnally & Bernstein, 1994). This confirms that the measurement items consistently capture the intended constructs.

3.1.4 Correlation Analysis

To examine the relationships between AI-supported learning, digital tool use, LMS engagement, and perceived learning outcomes, **Pearson correlation coefficients** were calculated.

Table 4.
Correlation Matrix

Construct	1	2	3	4
1. AI-Supported Learning	1			
2. Digital Tool Use	0.53**	1		
3. LMS Engagement	0.61**	0.48**	1	
4. Perceived Learning Outcomes	0.58**	0.47**	0.52**	1

Note: $p < .01$ for all correlations.

The correlation analysis indicates **significant positive relationships** among all constructs. AI-supported learning is most strongly correlated with perceived learning outcomes ($r = 0.58$), suggesting that students who use AI tools more frequently perceive greater academic benefits. LMS engagement also demonstrates a moderate positive correlation with learning outcomes ($r = 0.52$).

3.1.5 Regression Analysis

A **multiple linear regression** was conducted to determine the extent to which AI-supported learning, digital tool use, and LMS engagement predict perceived learning outcomes. The regression model was statistically significant ($F(3,316) = 116.72$, $p < .001$), explaining **52% of the variance** in perceived learning outcomes ($R^2 = 0.52$).

Table 5.
Regression Analysis Predicting Perceived Learning Outcomes

Predictor	B	SE B	β	t	p
AI-Supported Learning	0.41	0.05	0.41	8.20	<.001
Digital Tool Use	0.27	0.06	0.29	4.50	<.01
LMS Engagement	0.36	0.05	0.36	7.20	<.001

The results indicate that **all three predictors significantly influence perceived learning outcomes**, with AI-supported learning exerting the strongest effect ($\beta = 0.41$). LMS engagement ($\beta = 0.36$) and digital tool use ($\beta = 0.29$) also contribute positively. Variance inflation factors (VIF) were below 2 for all predictors, indicating no multicollinearity issues.

3.1.6 Interpretation of Findings

The results suggest that students perceive AI-supported learning tools as highly beneficial for enhancing understanding, problem-solving, and academic performance. Similarly, LMS engagement and digital tool usage are associated with higher levels of perceived learning outcomes. The strong correlations and regression coefficients indicate that technology integration in teaching positively affects students' academic experiences. These findings align with prior research emphasizing the importance of AI, digital tools, and LMS platforms in promoting learner engagement, motivation, and performance (Holmes et al., 2022; Ifenthaler & Yau, 2020).

The descriptive results highlight that students consistently interact with digital tools and LMS features, suggesting that higher education institutions in Sri Lanka have successfully implemented technology-enhanced learning strategies. However, the moderate standard deviations indicate some variation among students, which may reflect differences in digital literacy, access to technology, or familiarity with AI-based applications.

Overall, these results provide **empirical evidence** supporting the effectiveness of AI-supported

learning, digital tools, and LMS engagement in improving student learning outcomes. The study confirms that technology-integrated teaching has a measurable and positive impact on university students' academic experiences in the Sri Lankan context.

3.2 Discussion

The findings show that students strongly endorse technology-integrated teaching practices, with AI-supported learning emerging as the strongest predictor of academic outcomes. This suggests that personalized support from AI tools enhances problem-solving, feedback cycles, and conceptual understanding. Additionally, high LMS engagement reflects students' reliance on structured digital environments for accessing content and completing academic tasks.

The results align with global literature emphasizing that AI tools improve efficiency, access, and learner autonomy. The findings also affirm research indicating that digital literacy and tool familiarity significantly shape students' learning behaviours in blended environments.

The findings of this study reinforce the argument that AI-supported learning and LMS innovations are becoming central to the educational experiences of university students, particularly in blended and online learning environments. Students demonstrated strong positive perceptions of AI tools, suggesting a growing acceptance of automated feedback systems, intelligent tutoring interfaces, and generative AI technologies for academic support. This is consistent with global trends indicating that learners increasingly rely on AI for clarifying concepts, generating examples, and enhancing academic writing. The significant predictive power of AI-supported learning and LMS engagement on perceived learning outcomes suggests that technology-integrated teaching not only enhances content accessibility but also promotes student autonomy, motivation, and cognitive engagement. However, it is important to acknowledge that technology alone cannot guarantee learning success; effective integration requires thoughtful instructional design, pedagogical alignment, and the development of students' digital literacy skills. The results highlight an urgent need for universities to provide training for both students and faculty to use digital systems effectively while ensuring ethical and responsible use of AI tools. Overall, the study contributes to the understanding of how digital ecosystems shape contemporary higher education and provides empirical evidence supporting continued investment in AI-enhanced teaching practices.

4. Conclusions

This study examined the perceptions, engagement, and perceived learning outcomes of university students in relation to AI-supported learning,

digital tools, and LMS innovations within a Sri Lankan higher education context. The findings provide compelling evidence that technology-integrated teaching has a significant positive impact on students' academic experiences. Specifically, AI-supported learning tools, such as intelligent tutoring systems, adaptive quizzes, automated feedback mechanisms, and generative AI platforms, were found to enhance student understanding, foster self-regulated learning, and support cognitive development. Similarly, engagement with digital tools—including multimedia content, collaborative platforms, and simulation-based resources—contributed to deeper learning, improved motivation, and active participation in course activities. LMS engagement emerged as another key factor, with students reporting that features such as progress tracking, discussion forums, and interactive modules facilitated structured learning, increased accessibility, and provided a centralized environment for academic interactions.

The statistical analysis revealed significant positive relationships between AI-supported learning, digital tool use, LMS engagement, and perceived learning outcomes. AI-supported learning demonstrated the strongest predictive power, highlighting the growing importance of intelligent and adaptive technologies in modern pedagogy. These findings align with global literature on technology-enhanced learning and reinforce the notion that when appropriately integrated into curricula, digital tools and AI technologies can substantially improve learning effectiveness. Furthermore, the study emphasizes the interdependent nature of these technologies; LMS platforms serve as the backbone that organizes and streamlines interactions with AI tools and digital resources, creating a cohesive, technology-enabled learning ecosystem.

From a pedagogical perspective, the study underscores the importance of deliberate instructional design and institutional support in achieving meaningful technology integration. While the positive outcomes observed suggest high acceptance and usefulness of AI and digital tools, variations in student engagement indicate that factors such as digital literacy, technological infrastructure, and instructor facilitation remain critical determinants of successful implementation. This highlights the need for higher education institutions to provide ongoing faculty training, digital skills development for students, and technical support to ensure equitable and effective adoption of technology-enhanced learning practices.

In addition to practical implications, this study contributes to the theoretical understanding of technology acceptance and learning in higher education. By integrating the Technology Acceptance Model (TAM), the Unified Theory of Acceptance and Use of Technology (UTAUT), and Constructivist Learning Theory, the research provides insights into how perceptions of usefulness and ease of use, social and environmental factors, and constructivist pedagogical principles

collectively influence student engagement and learning outcomes. This integration offers a robust framework for examining technology-enhanced teaching and can inform future research across diverse educational contexts, particularly in developing countries where empirical evidence remains limited.

Despite its contributions, the study has certain limitations that should be acknowledged. Data were collected from a single university using a self-reported questionnaire, which may introduce response bias and limit generalizability. Additionally, while the study focused on perceived learning outcomes, objective measures of academic performance, long-term retention, and practical skill acquisition were not assessed. Future research could employ longitudinal designs, experimental interventions, and mixed-methods approaches to provide a more comprehensive understanding of the impact of AI and digital tools on student learning.

In conclusion, this study demonstrates that technology-integrated teaching, through AI-supported learning, digital tools, and LMS engagement, plays a transformative role in enhancing educational experiences in higher education. By promoting active learning, personalization, and student autonomy, these technologies not only improve engagement and satisfaction but also have the potential to foster deeper and more meaningful learning. As higher education continues to embrace digital transformation, the findings of this study provide valuable evidence and actionable insights for educators, instructional designers, and policymakers seeking to optimize teaching practices, enhance learning outcomes, and prepare students for success in increasingly technology-driven academic and professional environments.

Recommendations

1. Strengthen AI Integration:

Universities should expand the use of AI-driven tools—such as intelligent tutoring systems, automated feedback mechanisms, and predictive analytics—to support personalized learning and enhance student engagement.

2. Enhance LMS Design and Functionality:

Learning Management Systems should be improved by incorporating interactive dashboards, personalized learning pathways, and user-friendly navigation features that facilitate continuous learning and real-time progress monitoring.

3. Provide Comprehensive Professional Development:

Institutions should offer structured training programs for academic staff focused on AI literacy, digital pedagogy, and effective instructional design to ensure meaningful integration of technology into teaching practices.

4. Develop Clear Policies for Ethical AI Use:

Universities need to formulate guidelines that govern the ethical, transparent, and responsible use of AI in teaching and learning, ensuring data privacy, fairness, and accountability.

5. Implement Continuous Evaluation Mechanisms:

Regular monitoring of student engagement, learning behaviours, and system performance through analytics should be conducted to identify areas for improvement and to refine digital learning strategies over time.

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Conflicts of Interest

There are no conflicts to declare.

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