

EXPLORING THE IMPACT OF AI-POWERED LEARNING TOOLS ON STUDENTS ENGAGEMENT AND ACADEMIC PERFORMANCE: A SYSTEMIC REVIEW OF MODERATING FACTORS

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Abstract

The increasing rate of embracing artificial intelligence (AI) in higher institutions of learning globally has generated significant debate concerning its impact on student engagement and academic performance. While AI-powered tools promise personalized learning and greater efficiency, their effectiveness is highly dependent upon several moderating factors. An in-depth systematic review was deployed to investigate the relationship between AI-powered learning tools, student engagement, and academic performance, focusing on the moderating roles of perceived ease of use (PEOU), frequency of AI tool use, instructor training and support (IT&S), and student digital literacy levels. The detailed review synthesized existing literature to address vital research questions, exploring how these moderating factors influence the technology's effectiveness. The findings confirmed PEOU as the most significant predictor of positive student attitudes, while a higher frequency of AI tool use consistently correlates with better engagement and academic outcomes. Crucially, IT&S serves as the indispensable bridge, enabling instructors transition to student-centred models and effectively manage AI's ethical and logistical demands. However, the in-depth review suggests that digital literacy plays a complex, but an indirect role: though it is necessary for technical competence, it does not automatically ensure greater academic engagement, suggesting a persistent need for motivational approaches. These findings highlight the need for balanced AI incorporation that prioritize both academic success and student well-being. This review contributes key insights for policymakers and developers seeking to enhance AI-powered learning environments

Keywords: AI-Powered Learning Tools, Student Engagement, Academic Performance, Moderating Factors and Digital Literacy

Introduction

In the contemporary global educational dispensation, the threshold of learning across all dimensions has undergone a geometric transformation, mostly driven by rapid technological advancements and the proliferation of complex data. This development is most evident in the integration of Artificial Intelligence (AI) within teaching and learning procedures, a shift that marks a departure from traditional, one-size-fits-all pedagogical methods toward highly personalized learning journeys (Brendel et al., 2021; Olakunle, 2025). Within African higher education and beyond, building research and technological capacity has

become a matter of institutional survival. As universal knowledge economies shift, the innovative techniques employed in postgraduate and undergraduate training must move beyond passive consumption toward active, AI-enhanced engagement.

The world globally occupies an age characterized by constant revolution where methods of instruction must be as dynamic as the technologies it employs. Consequently, it is imperative for academic, researchers, and educational institutions to track these changes to remain pedagogically relevant (Alemán et al., 2019; Salama & Hinton, 2023). Over the last decade, Artificial Intelligence has emerged as a key enabler in this pursuit, offering a vast range

of tools from intelligent tutoring systems to generative content platforms that provide students with immersive and customized learning experiences (Alam, 2021; George & Wooden, 2023). However, while the availability of these tools is increasing, their actual impact on student engagement and academic performance remains a subject of intense scholarly debate.

As institutions struggle to meet the diverse needs of expanding student populations, AI technologies offer the necessary infrastructure to simplify personalized learning, making education more approachable and effective (Zawacki-Richter et al., 2019). Yet, the realization of these benefits is deeply influenced by a complex interaction of human and institutional factors. Precisely, factors such as student's Perceived Ease of Use, the Frequency of AI Tool Use, the Digital Literacy Level of Students, and the extent of Instructor Training and Support have emerged as critical variables. In spite of the growing number of individual studies on these topics, the literature remains fragmented, with conflicting findings regarding how these factors moderate the relationship between AI adoption and actual scholarly outcomes.

The current problem in higher education research is defined by the widening gap between the potential and the realized benefits of AI. This gap frequently results in inconsistent academic performance and a lack of critical engagement with research materials (Hennekeuser et al., 2024). Though, many students have become regular users of generative AI tools for convenience, yet this adoption is often organic and unsanctioned rather than guided by structured pedagogical design. Such trends lead to frequent instances of misuse, over-reliance, or underutilization, all of which negatively affect core learning goals and the development of independent research skills (Qadir, 2023). The magnitude of this issue is felt acutely in diverse academic environments where the digital divide may be augmented by a lack of familiarity with sophisticated AI functionalities.

Recent primary studies highlight a troubling paradox, in that, while some data show a positive correlation between the frequency of AI utilization and academic outcomes, other findings point to systemic risks such as diminished critical thinking and "cognitive

laziness" (Boubker, 2024; Holmes et al., 2023). This struggle is deepened when educators lack the necessary training to integrate AI effectively into the curriculum resulting in inconsistent policies regarding academic integrity. These interconnected challenges go beyond simple test scores; they threaten the very foundation of academic trust and the quality of scholarly authorship. While individual studies have touched upon these issues, there is a lack of comprehensive and systematic synthesis that evaluate these moderating factors in a unified framework.

However, one aspect that remains under-explored is how existing postgraduate and undergraduate programmes can be restructured to build researchers' capacities by specifically addressing these moderating variables. It is currently unclear how the "Perceived Ease of Use" of AI tools specifically influences the depth of student engagement, or to what extent "Instructor Training" serves as a barrier against the negative effects of AI over-reliance. Written guides suggest that for AI to realize its potential as a catalyst for excellence, research must identify the specific conditions under which these tools succeed or fail. Without a systematic review of these moderating factors, institutions will continue to implement AI policies in a vacuum, leading to inefficiency and widening equity gaps.

Therefore, this study conducts a systematic review exploring the impact of AI-powered learning tools on student engagement and academic performance, with a specific focus on identified moderating factors. This study aims to create existing evidence to determine how the Frequency of AI Tool Use affects engagement and performance across different educational backgrounds. Furthermore, this study investigates the extent to which "Perceived Ease of Use" influence student experience and the degree to which "Instructor Training and Support" impact the overall effectiveness of these digital tools. Critically, this study seeks to ascertain if the 'Digital Literacy Level' of students act as a significant moderator in the relationship between AI-powered tools and academic success.

By articulating these objectives, this study provides a relevant, evidence-based understanding of the key human technology connections that moderate the success of AI in

modern education. The narrative of this research moves from the broad importance of research capacity in higher education to the specific niche of how postgraduate training can be redesigned to strengthen skills through better-governed AI integration. Through this systematic review, the study identifies gaps in literature and provide a concise framework for future innovative training approaches. Ultimately, this work serves to tie the preceding background of technological proliferation to a rigorous evaluation of how these tools can be harnessed to ensure fairer, better, and more sustainable academic outcomes for all stakeholders in the digital age. This synthesis is essential for creating a coordinated policy that allows AI to fulfill its potential as a transformative force in higher education research.

Empirical Review

Perceived ease of use and Student Engagement and Academic Performance

Several studies confirmed Perceived Usefulness (PU) and Perceived Ease of Use (PEOU) as an ultimate driver of user intention and attitude, frequently leading to improved academic metrics. For instance, Shahrniza and Abubaker (2025) discovered a strong correlation between PU, PEOU, and Academic Achievement (CGPA) among over 200 undergraduates, concluding that technology adoption meaningfully impacts academic performance. Likewise, the study by Aldraiweesh and Alturki (2025) noted PU ($\beta=0.670$) and PEOU ($\beta=0.330$) as strong predictors of direct attitudes towards Artificial Intelligence (AI), which afterward enhanced students' intentions to use it ($\beta=0.760$). This discovery is resonated with Chen et al. (2025), who, in their investigation on humanoid robots among 508 students, established that both PU and PEOU strongly predict students' attitudes, which then influence their behavioural intentions. In addition, some scholars acknowledged the importance of PU and PEOU in relating external factors to internal user states. According to Tan et al. (2024), in the application of SEM analysis of hybrid learning among 444 students, discovered that PEOU and PU directly or significantly mediate the association between perceived service quality and students' favourable attitudes, thus acting as vital channels for system effectiveness. Dahri et al.

(2024), investigated AI tools in Malaysian and Pakistani institutions and revealed that the increased use of these tools, driven by factors linked to PU and PEOU (for instance, performance expectancy), significantly influenced learning outcomes and student satisfaction. These consistent discoveries underline the universal pertinence of the Technology Acceptance Model (TAM) model's fundamental concepts across diverse technologies and cultural backgrounds.

Studies with Mixed Findings

One of the major key findings that displayed the magnifying result of internal motivation on achievement was a study conducted by Shahrniza & Abubaker (2025). They established that the strong correlation between technology adoption (PU/PEOU) and CGPA is augmented by the mediating role of student motivation. This high pointed motivation is a serious factor in leveraging the potential of adopted technology. Nevertheless, the precise mediators between the TAM constructs and behavioural intention differ by technology. For AI-based tools, the study by Vidarshika, Dayapathirana, & Ranasinghe (2025) conveyed a novelty by discovery that anthropomorphism tendency acts as a positive moderator on the relationships of both PU and PEOU with AI ChatGPT usage behaviour. This advocated that human-like features are indispensable for engagement with precise AI tools. Contrarywise, Damien Tyron Naidoo's (2023) study on blockchain and AI in e-learning showed mixed results concerning individual traits: while learner self-efficacy had a significant direct effect on e-learning engagement, it did not moderate the relationship between behavioural use and performance, thereby restricting the role of a personal factor.

Concerning the system's external influence, Karl Mayr (2025) revealed that student interest significantly and directly moderated the relationship between AI adoption (by teachers) and teaching effectiveness, with an increasing interest augmenting the positive impact of AI. This disparities in the result by Adefuye Adetayo Linus et al. (2025), that simply acknowledged a strong and robust positive relationship between general observation of online tools and their perceived ease of use, suggested that for fewer novel

technology, the significant insight of usability is the leading factor.

Studies that Reported the Existence of Contradictions of the Direct Influence of Perceived Ease of Use

A significant contradiction emerged concerning the direct path from PEOU to intention to use, mostly with advanced AI applications, signifying that technology maturity and background influence the mechanism of adoption. Two autonomous studies on AI chatbots found a direct contradiction to the classical TAM model's expectation of PEOU directly leading to usage intention. Alshammari and Eldho Babu (2025), on the investigation of ChatGPT acceptance, discovered that PEOU had no direct impact on students' behavioural intention; rather, satisfaction was established as a full mediator between PEOU and behavioural intention. A comparable finding was reported by AlAjmi, AlRoshdi, and Rostaq (2024) on wide-ranging AI acceptance, maintaining that PEOU had no obvious direct effect on Intention to Use (ITU), with the influence being channeled through Individual Impact (IN). This contradicts the results of Pandewidinata et al. (2024), who, in their examination on AI Chatbot adoption among Jakarta students, showed that perceived usefulness, ease of use, and comfort are primary drivers of adoption and positive attitudes, implying a direct influence. Furthermore, it also contrasts the previous discovery that PEOU and PU are strong predictors of attitude in multiple studies reported by (Aldraiweesh & Alturki, 2025; Chen et al., 2025). The pattern advocated that for new, complex AI tools such as ChatGPT, ease of use is only treasured if it translates into a positive experience (satisfaction) or a tangible personal result (individual impact), before impacting the decision to use the technology. This complication is further emphasized by AlAjmi, AlRoshdi, and Rostaq (2024), who also reaffirmed that Perceived Trust (PT) has no direct effect on ITU, signifying an extremely precise set of mediating pathways for AI adoption compared to general technology use.

Frequency of AI tool use and Student Engagement and Academic Performance

The growing integration of Artificial Intelligence (AI) technologies into higher education presents a significant area of scholarly inquiry, particularly regarding its

broad impact on student engagement and academic performance across diverse university settings. According to a study by Fazil et al. (2024), which explored the intersection of AI, student engagement, and academic performance at Kabul University in Afghanistan, a quantitative approach involving 200 students utilized regression analyses and ANOVA on structured questionnaires. The study revealed commendable student awareness of AI in daily life, though academic integration still requires improvement. The ethical considerations and perceptions of autonomy emphasize the need for a holistic AI education approach, ultimately advocating for balanced AI integration to guide pedagogical strategies and curriculum development. Similarly, the study by Altememy et al. (2023) focused on the impact of AI tools on student performance in Iraq, specifically evaluating the mediating roles of student motivation and engagement. Using a quantitative approach and hierarchical regression with data from 312 university students, the analysis showed a significant impact of all addressed variables on student performance, highlighting the importance of motivation and engagement in this relationship.

In a related context focusing on the optimization of learning, Mirdad et al. (2024) investigated the integration of AI-based educational tools to enhance student engagement and academic performance. Through an experimental design with a control group and the use of SmartPLS for data analysis, the findings indicated that AI integration enables a more personalised and responsive approach to students' unique needs, suggesting a progressive step toward a more adaptive and effective education system. Kallamadugu (2025) also explored the effectiveness of AI-generated content, specifically voice-over presentations as an alternative to human-narrated lectures for students preparing for the FAA Part 107 exam. Employing a mixed-methods approach with quantitative analysis of exam scores and survey data, along with qualitative interviews, the study found no significant difference in exam performance, confirming AI lectures as a viable alternative, though students still valued human interaction for detailed explanations.

Also focusing on performance, Ward et al. (2025) analysed the impact of AI tools on student study habits and academic performance,

specifically assessing improvements in study habits, time management, and feedback mechanisms. Using a mixed-methods approach with surveys (Likert scale) and follow-up interviews, and employing descriptive and inferential statistics (T-tests, ANOVA, regression analysis) alongside thematic analysis, the study found a significant reduction in study hours and an increase in GPA. However, it also identified challenges like over-reliance on AI, emphasizing the need for AI to complement traditional strategies. Wazir et al. (2025) explored a predictive angle, analysing the effectiveness of integrating AI and Machine Learning (ML) models in handling educational data to predict academic performance and monitor student interactions. Using Decision trees, Neural trees, and ensemble methods on a dataset of 15,000 students, the analysis found high average prediction accuracy for academic results (92%) and engagement indicators (88%), highlighting the potential for early warning systems to cut dropout levels by 25%.

The positive influence of AI on engagement is further supported by Ezeoguine and Eteng-Uket (2024), who investigated the influence of AI tools on student engagement in higher education using a descriptive survey design with a diverse student sample. Utilizing mean, one-way, and two-way ANOVA, the results showed that the majority of students were extremely engaged as a result of AI tool use, with no significant effect of gender or age, underscoring the universal appeal and importance of inclusive AI integration. Similarly, Eltahir and Babiker (2024) investigated the impact of AI-powered personalised learning tools on academic performance and perceptions of pre-service student teachers at Ajman University. Employing a quasi-experimental design with 55 students in the experimental group using AI tools and 55 in the control group receiving traditional instruction, statistical analysis of pre- and post-tests, rubric assessments, and questionnaires revealed significant differences favouring the experimental group in academic performance, knowledge retention, critical thinking, motivation, and engagement, thus underscoring AI's transformative potential.

The effectiveness of AI tools is even noted across specialized groups. Swargiary (2024) investigated the impact of AI tools on the academic performance and engagement of

Grade 12 students with special educational needs (SEN) at NIS Academy. Employing a laboratory experimental research design with a pre-test and post-test control group approach (60 students total), the findings revealed significant improvements in both academic performance (mean post-test score increase from 67.2 to 77.1 for the experimental group) and engagement (SEI mean score increase from 33.7 to 40.3 for the experimental group). This study's qualitative data highlighted the effectiveness and user-friendliness of the tools. Yakhina et al. (2024) specifically explored the use of AI technology in language learning for engineering students. Their study, which assessed the impact of AI-powered tools on student engagement and academic performance, found that the tools were effective in improving English language proficiency and provided positive student feedback, suggesting significant implications for integrating AI into specialized language learning programs.

However, the impacts of AI on the student experience also include emotional and well-being considerations. Bhimavarapu (2025) investigated the effectiveness of AI tools in enhancing student satisfaction in university education by using advanced data analysis techniques, specifically Multivariate Adaptive Regression Splines (MARS) and Convolutional Neural Networks (CNNs). This innovative methodological framework sought to capture in-depth student emotions and satisfaction levels by modelling nonlinear relationships and analysing unstructured data like text feedback and engagement patterns. Furthering this emotional focus, Zhang and Liu (2025) tracked the evolving impact of AI-driven learning platforms on EFL students' burnout, emotional dysregulation, and well-being throughout a semester. Using Latent Growth Curve Modeling (LGCM) on data from 909 Chinese college students, the results suggested that while students experience fluctuations in emotional states, the integration of AI-driven platforms influences initial emotional states, with personalised learning potentially alleviating burnout but also possibly leading to dysregulation for some. The effectiveness of the platforms was found to depend on the tools' design and student engagement with the technology.

A clear similarity emerges across the literature - AI integration is generally related

with significant improvements in academic performance and student engagement across diverse geographical (Afghanistan, Iraq, global), institutional (Kabul University, Ajman University, University of Port Harcourt), and specialized backgrounds (engineering students, SEN students). Studies constantly engaged quantitative methods, often incorporating experimental or quasi-experimental designs (Eltahir & Babiker, 2024; Mirdad et al., 2024; Swargiary, 2024) or advanced statistical modelling (Altememy et al., 2023; Wazir et al., 2025; Bhimavarapu, 2025), to validate the positive relationship between AI tool use and learning outcomes (Ward et al., 2025). Also, a common conclusion across the studies (Fazil et al., 2024; Eltahir & Babiker, 2024; Mirdad et al., 2024) is the promotion or advocacy for a balanced, all-inclusive, and personalised method to AI integration that provides an exceptional student needs and improves adaptive learning.

Though, there are inconsistencies and diverse limitations in the results reported. Despite the fact that AI has been long-established as a viable substitute for performance outcomes (Kallamadugu, 2025), student perceptions and emotional well-being introduce impediment. Kallamadugu (2025) opined that students still prefer human interaction for thorough clarifications in spite of no difference in examination performance. Equally, the study by Zhang and Liu (2025) recommends a contradiction, that is, while personalised AI learning can alleviate burnout, it may simultaneously contribute to emotional dysregulation for some, demonstrating that the influence on well-being is not homogeneously positive. One more significant contradiction noted by Ward et al. (2025) is the risk of over-reliance on AI, which requires that AI balances rather than changes old teaching methods, an ethical and pedagogical contest as well introduced by Fazil et al. (2024) and Ward et al. (2025). Lastly, despite the fact Ezeoguine and Eteng-Uket (2024) found a universal appeal of AI across gender and age, Wazir et al. (2025) introduced boundaries like data security and inherent model bias, signifying that the wider, ethical, and technical scalability for broader adoption remains a substantial concern in spite of the promising performance and engagement outcomes.

Instructor training and support and Student Engagement and Academic Performance

According to Tang (2024), a comprehensive examination of over 55 papers found that AI is helpful in shifting education from a teacher-centred to a student-centred model. The study carried out by Tang outlined numerous significant opportunities, as well as the creation of intelligent content and the development of intelligent tutoring systems that offered personalised and adaptive educational experiences. These systems are premeditated to enhance student engagement by presenting diversified learning modes via multimedia and interactive tools. This viewpoint is strongly reinforced by Mncedisi, Maphalala, Mkhasibe, and Mncube (2025), who, in an evaluation of AI in Open Distance e-Learning (ODEL), emphasized the transformative potential of AI-powered e-tutors. Their results showed how these tools can foster self-directed learning by offering personalised learning experiences, real-time feedback, and improved learner motivation. Also, the study by Eltahir et al. (2024), which applied a quasi-experimental design with 110 pre-service teachers, provides empirical evidence for these claims. Their discoveries confirmed that students using AI-powered personalised learning tools showed significant improvements in academic performance, knowledge retention, critical thinking, and engagement compared to a control group receiving traditional instruction. This study provides a powerful case for the tangible benefits of AI in practice.

Similarly, in a study by Sasikala and Ravichandran (2024), through a thorough literature review, more so reported that AI's role in personalizing learning, enhancing student engagement, and improving academic performance is a core benefit. In a systematic review of 63 articles, Luo et al. (2025) resonated these sentiments, categorising that AI tools mostly function as aids for assessment and evaluation, personalised feedback, and intelligent tutoring. Their revealing indicated that these tools mostly advance cognitive knowledge acquisition and affective learning outcomes, buttressing the idea that AI positively influences student learning.

The benefits of AI likewise, is also extend to logistical features of education. For instance, Mounkoro et al. (2025), in a quantitative survey of 250 teachers, reported

that the widely held favoured AI tools for enhancing classroom management and workflow, although there is no evidence of a direct correlation between usage frequency and perceived effectiveness from the study's data. In addition, Seo (2021), in an investigation analysed the perceptions of 12 students and 11 instructors, finalised that AI systems have the potential to aid personalised learner-instructor interaction at scale, enhancing the quantity and quality of communication and support. Tehran et al. (2025), via a narrative review, precisely emphasized how AI-powered tools can enhance icebreaking activities, making them more engaging and personalised while freeing up educators' time by automating routine tasks.

Similarities and Contradictions (Studies with Mixed Results)

There is evidence of a strong consensus on the potential of AI to revolutionize education by personalising learning, automating tasks, and enhancing engagement in the reviewed literature. This is consistently maintained by discoveries from Tang (2024), Mncedisi et al. (2025), and Sasikala and Ravichandran (2024). The empirical evidence from Eltahir et al. (2024) further solidifies this view, showing tangible improvements in student performance. However, a central idea of blend lies in the shared recognition of important challenges. All the studies that explore into limitations (Tang, 2024; Poursalim, 2025; Tiwari, 2023) converge on main issues such as equity, ethical considerations and data privacy. Besides, there are specific inconsistencies that temper the keen viewpoint. The lack of a direct correlation between usage and effectiveness in the investigation by Mounkoro et al. (2025) and the non-significant relationship between particular tools and information literacy reported by Ummuhan Avcı and Esin Ergun (2022) (which emanated from the former user prompt nevertheless is germane here) advocate that the impact of AI is not monolithic and rest heavily on implementation and framework. The awareness raised by Seo (2021) about social boundaries and surveillance, and by Tehran et al. (2025) about diminished human connection, serve as imperative cautions that pinpointed the need for a balanced approach to integrating AI into educational settings. The literature, hence, submits that while AI holds immense promise, its successful implementation requires a

thoughtful, ethical, and context-aware strategy that prioritises human-centered design.

Digital literacy level of students and Student Engagement and Academic Performance

A consensus has occurred in the literature that digital literacy, academic engagement, and academic performance are positively and significantly linked. For instance, the study of Harimurti et al. (2024) investigated the impact of academic engagement and self-efficacy on digital literacy learning achievements, revealing that these two traits accounted for a considerable 81.8% of the variance. This result emphasizes their importance, especially within the background of online learning. Similarly, correlational studies by Solomon Moses (2024) and a meta-analysis by Ocvita Ardhiani et al. (2023) in addition validate this relationship. Moses's study on Nigerian students discovered a strong association ($r=0.622$) between digital literacy and academic performance, whereas Ardhiani et al.'s meta-analysis of 15 studies established a moderate but significant direct correlation ($r=0.31$) at the university level.

Further study has also discovered the interconnectedness of these variables. Fitra Jaya and Adisthy Shabrina Nurqamarani (2023) settled that both digital literacy and academic self-efficacy are decisive for fostering student engagement in hybrid learning environments. They contended that a student's self-confidence in the use of digital tools directly supports active participation. This is also inline with the reports of Kristanto et al. (2025), who confirmed a significant association between digital literacy and student engagement in achieving seamless learning. In another related investigation, Aulia Sanova et al. (2022) acknowledged a strong simultaneous outcome between digital literacy and students' autonomous learning, mostly when utilizing e-modules. The gain and significance of integrating technology is likewise reverberated by V. Kanchana et al. (2025), who pointed out that a nonexistence of technology use and engagement contributes to digital illiteracy, and they recommend improving pedagogical methods to better integrate digital tools.

The Existence of Contradictions

Despite the general agreement, some studies introduce important nuances and contradictions regarding the direct effects of these variables.

For instance, while both digital literacy and student engagement were found to be significantly correlated with learning achievement by Triana and Suryadi (2025), they found no significant association between digital literacy and engagement itself. This suggests that simply possessing digital skills may not be enough to directly foster greater academic involvement.

Similarly, other studies challenge the assumption of a direct causal link. Asri Widowati et al. (2023) found that digital literacy and academic engagement did not directly influence academic performance. Instead, their structural equation modeling analysis revealed a more complex, indirect pathway where engagement moderates the impact of digital literacy on self-efficacy, which then, in turn, influences academic achievement. This finding points to a complex, multi-layered relationship rather than a simple linear one. Additionally, Ümmühan Avcı and Esin Ergün (2022) found a key distinction in their study on Learning Management System (LMS) activities. While participation levels influenced academic performance and engagement, they had no effect on information literacy. This suggests that general digital participation and specific skills like information literacy may be influenced by different factors, indicating a need for more granular research on the components of digital literacy.

On the aspect of the factors influencing student success, quite a lot of investigations have found a significant relationship between various key variables, while others present more complex, non-significant findings that challenge a straightforward causal link. Harimurti et al. (2024), Solomon Moses (2024), Ocvita Ardiani et al. (2023), and Fitra Jaya and Adisthy Shabrina Nurqamarani (2023) wholly established a significant and positive relationship between digital literacy, academic engagement, and academic performance. These studies constantly validate that a student's ability to use technology efficiently, their level of participation, and their academic self-efficacy are key to their learning achievements. This is moreover, reaffirmed by Aulia Sanova et al. (2022), Kristanto et al. (2025) and Triana and Suryadi (2025) who found a significant correlation between digital literacy and engagement.

On the contrary, some studies confirmed a non-significant association. For instance, Triana and Suryadi (2025) similarly reported a no significant relationship between digital literacy and student engagement, signifying that digital skills do not automatically lead to greater involvement in learning. This disparities with the direct associations revealed in other related studies. In addition, the study by Asri Widowati et al. (2023) established that digital literacy and engagement did not directly affect academic performance. Their results recommended a more intricate, indirect pathway where engagement regulates the effect of digital literacy on self-efficacy, which then influences academic achievement. Equally, Ummuhan Avcı and Esin Ergün (2022) revealed that while student participation in online learning management systems was significant for engagement and academic performance, it had no relevance impact on information literacy, indicating that particular digital skills may not the same or a one-way impact.

Research Methodology

The methodology used in this study will be a systematic review of the existing literature on the Exploring the Impact of AI-Powered Learning Tools on Student Engagement and Academic Performance: A Systematic Review of Moderating Factors, with a focus on the potential of AI to personalise and improve student learning performance

The study selection process followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 guidelines (O'Dea et al. (2021)). The systematic search across three primary databases Google Scholar, IEEE, and Xplore Digital Library yielded an initial pool of 76 records ($n = 35$, $n = 15$, and $n = 26$, respectively). Following the removal of 7 duplicate records, 69 unique titles and abstracts were screened for relevance. During this initial screening phase, 8 records were excluded as they did not align with the core research objectives. The remaining 61 reports were sought for retrieval and subjected to a rigorous full-text eligibility assessment. Upon detailed review, 13 articles were excluded based on predefined criteria, such as., incompatibility with study design. Ultimately, 48 high-quality articles met all inclusion criteria and were synthesized in this review. The complete

selection lineage is illustrated in the PRISMA flow diagram (see Figure 1).

It is imperative to note that the sources and the methodology used in this study are not exhaustive and there are many other studies and research papers that are not covered here, however it provides a good overview of the present state of research on the topic in addition to the results of this literature.

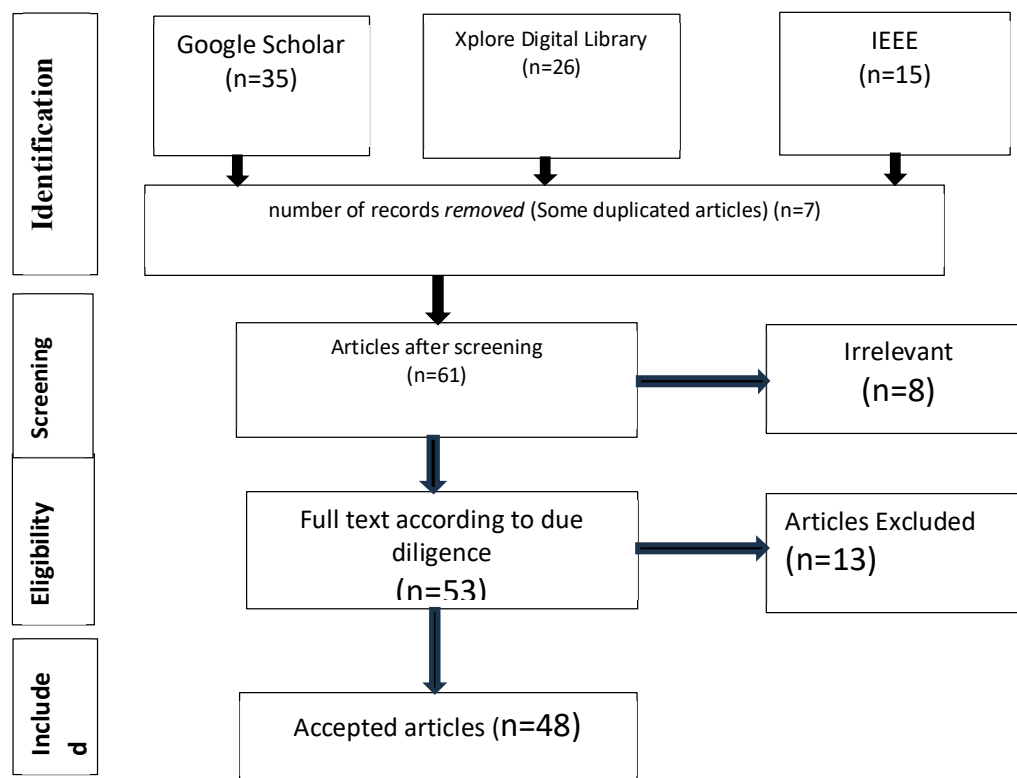


Figure 1: Study Selection and PRISMA Flow

Ethical Consideration

In carrying out the literature review, ethical consideration will emphasis on ensuring the correct representation and citation of sources. The research adheres to academic integrity standard, avoiding plagiarism and making sure that all references are properly cited. In addition, attention was paid to the ethical matters discussed in the literature. Such as data privacy and confidentiality information, algorithmic bias, and the digital divide, and how these factors might influence the interpretation of AI's impact on education.

Results and Discussion

The findings of this systematic review are organised according to the four research questions that guided the study. Following the

objective presentation of the data synthesised from the identified literature, each section provides a critical discussion that contextualise these results within the broader framework of higher education capacity building.

Research Question 1: To what extent does the perceived ease of use of AI-powered learning tools influence student engagement and academic performance?

The systematic review of the literature revealed a strong and consistent body of evidence, largely rooted in the Technology Acceptance Model (TAM), identifying Perceived Ease of Use (PEOU) as a dominant factor influencing student engagement. As illustrated in the synthesised data from Chen et al. (2025) and

Dahri et al. (2024), PEOU alongside Perceived Usefulness (PU) stands as a robust predictor of positive student attitudes and behavioural intentions toward AI tools. Specifically, Shahrniza and Abubaker (2025) established a statistically significant correlation between these TAM constructs and Cumulative Grade Point Average (CGPA), suggesting that the adoption of technology is a primary driver of academic achievement. Furthermore, Aldraiweesh and Alturki (2025) demonstrated that higher levels of PEOU significantly improved students' intentions to integrate AI into their study routines.

These findings suggest that the technical accessibility of AI tools is the gateway to meaningful engagement. When students perceive a tool as intuitive and user-friendly, the cognitive load required to operate the technology is reduced, allowing them to focus on the substantive content of their research. This aligns with the broader capacity-building frameworks which argue that for technological integration to be successful in African higher education, the tools must not present a barrier to entry. However, a notable distinction in the results indicates that while PEOU is a significant predictor, it does not act in isolation; it must be coupled with the student's perception of the tool's utility. One possible explanation for the high correlation with CGPA is that user-friendly AI tools allow for more efficient time management and data processing, which are essential components of academic success.

Research Question 2: How does the frequency of AI tool use affect student engagement and academic performance in educational settings?

The systematic examination of the relevant literature revealed a robust positive correlation between the frequency of AI tool integration and subsequent improvements in academic performance. This pattern was observed across diverse demographic and geographical backgrounds, notably in studies by Fazil et al. (2024) and Altememy et al. (2023). In particular, experimental groups that utilised personalised AI tools frequently showed marked improvements in knowledge retention and critical thinking skills compared to control groups (Eltahir & Babiker, 2024; Wazir et al., 2025).

The evidence indicates that regular interaction with AI-powered platforms fosters a learning-by-doing environment that reinforces cognitive gains. Unlike traditional methods where feedback may be delayed, the frequent use of AI provides real-time corrections, which explains the significant increase in knowledge retention scores noted in the results. These findings echo previous capacity-building efforts that emphasise the importance of consistent engagement with digital resources. Nevertheless, it is crucial to interpret these results with caution; while frequency is linked to performance, it must be integrated as a complementary strategy rather than a replacement for human-led instruction. The risk of over-reliance remains a significant challenge, suggesting that universities should encourage frequent but "principled" use of AI tools.

Research Question 3: How does instructor training and support impact the effectiveness of AI-powered learning tools on student engagement and academic performance?

The literature reviewed established that Instructor Training and Support (IT&S) serves as the indispensable bridge for successful pedagogical transition. Data from Luo et al. (2025) indicate that when instructors are properly supported, AI tools advance both cognitive knowledge acquisition and affective learning outcomes. A systemic shift from teacher-centred to student-centred models is facilitated by AI, yet this transition is dependent upon the instructor's ability to navigate the tool's interface (Tang, 2024; Mncedisi et al., 2025). Furthermore, reports by Mounkoro et al. (2025) and Tehran et al. (2025) affirmed that trained instructors favour AI for enhancing classroom management and automating routine tasks.

These results highlight a critical institutional implication: the effectiveness of AI is largely moderated by the "human in the loop." If instructors are not adequately trained, even the most sophisticated AI tool remains under-utilised or misapplied. This finding contrasts with earlier, more techno-deterministic views that suggested AI might replace the educator. Instead, this review reinforces the idea that AI acts as an assistant that frees up the instructor to engage in higher-level mentorship. For policymakers, this suggests that the budget for AI implementation must include a significant

portion dedicated to continuous professional development for staff to ensure that the transition to student-centred models is not merely theoretical.

Research Question 4: Does the digital literacy level of students moderate the relationship between AI-powered learning tools and student engagement and academic performance?

Contrary to the assumption of a simple direct link, several structural analyses in the reviewed literature found that digital literacy does not always directly influence academic performance (Widowati et al., 2023). Instead, the data suggest a more intricate, indirect mechanism. For instance, Triana and Suryadi (2025) identified a significant correlation between literacy and achievement, yet found no significant association between digital literacy and engagement itself.

This finding provides a significant contribution to the current understanding of the digital divide. It implies that merely possessing technical skills digital literacy does not automatically translate into active academic involvement or engagement. A possible explanation is that digital literacy is a necessary prerequisite, but it is not a motivator in its own right. Students may know how to use the tools, but without institutional strategies to motivate their application toward specific research goals, the literacy remains dormant. This challenges the notion that simply providing digital skills training will fix engagement issues; instead, it points to a need for pedagogical designs that explicitly link digital skills to research tasks.

Limitations and Future Research

This systematic review is limited by the rapid development of AI technology, that is to say that some studies published during the review period may have used tools that are already outdated. In addition, the dependence on self-reported data in many of the primary studies reviewed may introduce response bias. Future study should focus on longitudinal studies that track the impact of AI on postgraduate research output over several years, rather than single-semester assessments.

Conclusion

The systematic review of this study has successfully addressed the critical research gap

identified at the onset, the need for a comprehensive understanding of the moderating factors that dictate the success of AI integration in higher education. In summary, the study found that the transition from traditional pedagogical models to AI-enhanced environments significantly strengthens student engagement and academic performance, provided that the implementation is grounded in human-centred design. By creating evidence across various institutional settings, this study confirms that the potential of AI is not a static attribute of the technology itself, however has a dynamic outcome of how well-structured postgraduate and undergraduate programs account for user specific and institutional variables.

The findings validate the premise that Perceived Ease of Use and Frequency of Tool Use are the primary drivers of technology adoption; though, their impact on scholarly capacity is non-linear. The study demonstrates that these drivers are most effective when supported by high levels of student digital literacy, which ensures that frequent use translates into critical engagement instead of cognitive laziness. Most importantly, the review highlights that Instructor Training and Support (IT&S) serves as the requisite connection, enabling educators to pilot the ethical complexities of AI while fostering a student-centred approach. This reinforces the study's core argument that building research capacity in the digital age requires a shift in focus from the acquisition of tools to the cultivation of the human skills necessary to govern them.

Going forward, these findings indicate that academic leaders and policymakers must move beyond the mere provision of AI infrastructure. To truly enhance research skills and ensure equitable outcomes, universities should adopt training models that integrate digital literacy into the core curriculum and prioritise continuous professional development for staff. The future of higher education research depends not on the replacement of the human element by autonomous systems, but on a balanced, a principled integration where AI serves as a complementary catalyst for excellence. By addressing these moderating factors, institutions can ensure that the ongoing technological transformation leads to a more robust, inclusive, and effective global knowledge economy.

Recommendations

To bridge the gap between technological potential and academic achievement, it is recommended that higher education institutions transit from passive AI adoption toward a Structured Pedagogical Integration Framework that prioritize "Instructor Training and Support" as the primary catalyst for transforming AI from a potential distraction into a student-centred research tool. By embedding mandatory digital literacy and ethical modules into the core research curriculum, universities can ensure that Perceived Ease of Use and Frequency of Tool Use led to genuine skill acquisition instead of cognitive over-dependent. Eventually, this human-centred design must be supported by diagnostic assessments at the point of entry to mitigate the digital divide, thereby ensuring that the benefits of personalised, adaptive learning are equitably harnessed to enhance global research capacity and scholarly excellence.

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