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Relationships between Artificial Intelligence Use and Student Learning Outcomes: Private University in Siem Reap Province, Cambodia

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ABSTRACT

This research aims to assess the effects of AI use on student learning outcomes among students from universities in Siem Reap Province, Cambodia. This research employed a quantitative and qualitative approach and collected data from 192 private university students in Cambodia. Descriptive statistical tools (mean, frequency, and percentage) and inferential statistical tools (regression) in SPSS (PROCESS v4.2 by Andrew F. Hayes) were used to analyse data on the relationships between AI use and learning outcomes, between student engagement and personalised learning experiences, and between AI use and academic learning outcomes. AI use was positively related to student learning outcomes. Moreover, student learning engagement and personalised learning experience partially mediate the relationship between artificial intelligence use and student learning outcomes.

Keywords: artificial intelligence, learning engagement, learning experience, learning outcome

INTRODUCTION

In the 21st century, technology, including artificial intelligence, has rapidly advanced. Global interest increased in the revolutionisation of social aspects, including education. Artificial intelligence (AI) industries have become more advanced, and technology has been used in education to enhance learning experiences (Chiu et al., 2023).

Universities have used artificial intelligence to enhance their position (George & Wooden, 2023). The application of AI in education has improved student motivation, engagement, and performance. For example, AI-powered tools enable students to receive feedback to improve their work, leading to better learning outcomes (Vieriu & Petrea, 2025).

Most students have used artificial intelligence (AI) for their learning, including Grammarly, Quill Bot, Google Translate, and ChatGPT, but no training has been given to the majority of the surveyed

students. Cambodian English students had intentions for AI use in English learning, such as translation, research, and assignments, which contributed to learning outcomes (Sol, Heng & Sok, 2024).

Teachers and students use AI to access resources and tools. This technology can increase collaboration and participation among students and teachers. Students can use AI to develop the skills they need. These tools include individualised learning experiences and adaptive feedback systems (Jameel & Arsalan, 2024).

Concerns have been raised about the use of artificial intelligence, particularly regarding its accuracy and reliability. Additionally, the use of AI has led to a decrease in human interaction, which may adversely affect critical thinking skills because of an overreliance on AI and raise ethical issues stemming from its misuse (Sarin & Kimkong, 2024).

AI-driven technologies influenced student engagement. Long et al. (2026) linked the technology to personalised learning, real-time feedback, gamification, resource accessibility, affective comfort, and contextual adaptability (Long et al., 2026). Artificial intelligence was important in facilitating personalised learning, which contributed to improved motivation and active participation. Shang (2024) and Long et al. (2026) reported that a cloud-based K-means clustering system used for Chinese language instruction increased student engagement (Long et al., 2026; Shang, 2024). A spark-based recommendation model to align content delivery with learner needs enhances both participation and knowledge acquisition (Liu & Yushchik, 2024; Long et al., 2026). Ellikkal and Rajamohan (2025) reported a positive relationship between student engagement and academic learning outcomes. Artificial intelligence helps teachers address personalisation to meet the dynamic needs of their students (Hernández-Herrera et al., 2026). Singh, Singh and Alam (2026) reported positive and significant effects of AI tools on psychological factors. Student engagement partially mediates the effects of AI tools on academic success (Singh et al., 2026). Engagement plays a role as a mediator in the relationship between AI integration and performance (Hassan, 2026).

Researchers have conducted several studies on the use of artificial intelligence in education in Cambodia. However, those studies still have some gaps. Pum and Sok (2024) identified both concerns and benefits of leveraging AI in education in the Cambodian context. The research was based on a desk review of 16 articles published between 2022 and 2024. The research also revealed the benefits of AI use, such as personalised learning, innovative pedagogy, writing assistance and administrative support. The study raised concerns about AI use, including a decline in creativity, bias, misconduct, and privacy. Their study lacked empirical tests due purely to secondary data synthesis. Moreover, personalised learning and engagement were mentioned but not operationalised as mediators. Analysis of the relationship between AI use and student learning outcomes is lacking (Pum & Sok, 2024).

Another study by Hoeurng et al. (2024) examines the relationship between AI use and the chosen field of study; analyses students' perceptions of AI use in their research; and assesses the perceived significance of AI integration in specific majors: language education, agriculture science, engineering, business administration, and social science. The data were collected from students at three universities in Battambang Province. The participants focused on a bachelor's degree. This study used a qualitative survey with 370 students at Battambang University. The study revealed that there was high engagement with AI tools, value for efficiency and personalised learning, concern about bias, and a decline in critical thinking and privacy. The gaps of this study were that it examined AI use patterns, but there was no test of the causal relationship between AI use and academic learning outcomes and results, with a descriptive lack of explanatory and mediation effects not modelled in the analysis.

Sol et al. (2024) examined artificial intelligence (AI) use for language learning education with 328 students majoring in English. The study focused on students' experiences, perceptions, and attitudes toward the use of AI in English language learning, including the reasons for using AI, the training received on AI, the effectiveness of AI, knowledge of its strengths and weaknesses, and the challenges and opportunities associated with AI in English language learning. The gap in the study was that it focused solely on English major students, which limited the understanding of AI use among subjects related to their majors. Moreover, analyses of the relationship between AI use and student learning outcomes are lacking. Analysis of how

personalised learning experience and engagement mediate the ability of AI use to predict student learning outcomes is lacking.

Moreover, some studies have highlighted various arguments regarding the use of AI in education. Some studies have reported positive results of AI for education, such as the enhancement of student engagement, motivation, and achievement (George & Wooden, 2023). However, Sarin and Kimkong (2024) raised concerns about AI use in education, reporting a lack of human interaction and the ethical risks associated with its improper use.

To fill the gaps of the previous studies and validate the contradictory study findings, this study is proposed to address these gaps. This study aims to explore the relationship between AI use and academic outcomes and the effects of personalised learning experience and engagement on the relationship between AI use and student learning outcomes: a case study with university students in Siem Reap, Cambodia. This study provides causal and mediation analyses, which are not just descriptive or a second document review; it expands the scope from English majors to other disciplines and geographical areas. This research also empirically validates the personalised learning experience and engagement as mediators, which the prior studies from Cambodia discussed conceptually.

Hypothesis

H1: There is a positive relationship between AI use and student learning academic outcomes.
H2: Student learning engagement mediates the relationship between AI use and student learning academic outcomes.
H3: Personalised learning experience mediates the relationship between AI use and students' academic learning outcomes.

LITERATURE REVIEW

This section discusses constructivist theory and an empirical review of artificial intelligence (AI) use, staff engagement, personalised learning experiences, and students' academic outcomes.

Constructivist Theory

This constructivist theory was attributed to Lev Vygotsky in 1978 (Amineh & Asl, 2015). Constructivist theory refers to effective learning strategies that maximise student comprehension and develop an individual's ability to actively and creatively construct his or her knowledge and understanding. From a pedagogical perspective, this theory emphasises the necessity of active engagement in the educational process. This theory emphasises that learners not only access information but also participate in constructing its meaning (Hidayat et al., 2025). Constructivism covers the active process of building, refining, and developing knowledge and understanding (Hidayat et al., 2025; Suryana et al., 2022). Constructivist theory in an educational context refers to the importance of interaction between learners and educators in fostering a productive learning environment. Effective learning is the creation of a setting in which learners and educators actively contribute to the deeper and broader construction of knowledge. Educators play roles not only as content providers but also as factors that help students navigate their own way to understand the world (Hidayat et al., 2025). Effective learning encompasses the skills that enable students to continuously adapt and revise their knowledge in response to the evolving realities of life (Hidayat et al., 2025; Suryana et al., 2022).

The use of artificial intelligence (AI) has encouraged students to actively interact with the content. Constructivism promotes greater comprehension and memory of information. An AI-powered learning management system (LMS) can evaluate student data to develop customised learning plans that address individual requirements. This LMS highlights personalised and hands-on learning (Angraini et al., 2024).

Machine learning algorithms predict student performance and facilitate prompt interventions, thereby supporting the constructivist approach by allowing continuous feedback and adjustments (Vijayakumar Bharathi & Pande, 2024). Artificial intelligence (AI) and machine learning (ML) have significantly transformed learning management systems (LMSs) by providing personalised learning experiences and enhancing administrative efficiency. Learning is a social process that enhances student interaction and collective knowledge construction (Olabanji et al., 2024). It emphasises active learning and knowledge to facilitate student engagement, collaboration, and the co-construction of knowledge (Rohde et al., 2023).

Students can access learning resources and rapid feedback through the use of artificial intelligence, including chatbots and virtual assistants. The use of such AI tools was beneficial for students in completing exercises and developing divergent, creative, and critical thinking skills. Moreover, it provides students with a chance for their cognitive growth (Huang et al., 2024; Pang et al., 2025). Moreover, Yeol-Eo Chun and colleagues reported that AI-based adaptive learning provides personalised content based on medical students' levels. The use of AI motivates learning, optimises the learning process, and improves learning outcomes (Chun et al., 2024; Pang et al., 2025).

Artificial Use in Education

The field of AI emerged in the 1950s. Artificial intelligence is defined as "the capability of computer systems or algorithms to imitate intelligent human behaviour." The European Council defines artificial intelligence (AI) as "systems that display intelligent behaviour by analysing their environment and taking actions—with some degree of autonomy—to achieve specific goals" (Wadoux, 2025).

Different types of artificial intelligence tools have been used in higher institutions: ChatGPT, AvidNote, Elicit, Perplexity, Consensus, Semantic Scholar, Research Rabbit, Scholarcy, Mendeley, Zotero, and ChatPDF. Some tools are used for referencing and data management, whereas others are used to help and improve writing. Grammarly and WriteLab are used to improve the grammar and sentence formatting of the work. Moreover, some artificial tools are used for teaching and conferences, including Zoom, Google Meet, Webex, Microsoft Teams, WhatsApp, Instagram and Moodle (Kokina et al., 2025).

Artificial intelligence (AI) has been used in education, and its use has changed the education process and management (Martínez-Comesaña et al., 2023). Moreover, artificial intelligence has been used in online learning and teaching to automate instructors' mundane activities, to personalise learning for students, and to enable adaptive evaluation (Seo et al., 2021).

Artificial intelligence can enhance education through personalised instruction, adaptable assessments, smart tutoring systems, automated evaluations, immersive virtual reality experiences, data analysis for predicting educational outcomes, language acquisition, and a strong focus on accessibility and inclusivity, among numerous other tools and features (Xu et al., 2019).

Student's Academic Performance

Some variables are related to academic accomplishment, including parental involvement, family size, study hours, and the competencies of a teacher (Tadese, 2022). Rapid advances in technology over the past decade have increased access to large datasets. This advanced technology includes social media, sensors, mobile devices, and online learning environments (e.g., MOOCs, LMSs, and intelligent tutoring systems). This led to the accessibility of a wider range of complex datasets, including personal information of students, physiological data, academic records, learning histories, and additional information (Daniel, 2015).

AI-driven individualised learning systems were developed and designed to reduce educational gaps by offering disadvantaged populations needs-based support and promoting improved student performance through increased cognitive engagement (Boninger et al., 2020).

These initiatives also highlight the growing recognition of AI as a significant area of study with the potential to transform future learning paradigms (Miao et al., 2021). Artificial intelligence is drawing attention to a wide range of topics in education, including learning, teaching, evaluation, and even institutional management (Gonzalez-Calatayud et al., 2021).

The OECD encourages the use of big data technologies and learning analytics to improve educational endeavours. Most studies indicate that using AI technologies enhances academic performance (Chiu et al., 2023). Two studies that did not show such a significant improvement in performance reported that students' interest and confidence in learning increased (Topal et al., 2021).

AI improved both the performance of pupils with specific needs and that of the general population (Chiu et al., 2023). A braille instructor powered by artificial intelligence was developed to help visually impaired students learn, and it was shown that when teachers utilised the AI tutor, the students' responses were noticeably faster and more accurate. However, several studies show that not all children benefit from this AI technology, as these studies focus primarily on high achievers or those who are motivated to succeed. For example, in AI learning, kindergarteners with average handwriting abilities were the only ones who could exceed the head of beginners (Bonneton-Botté et al., 2020). Chiu et al. (2023) reported that only the most successful pupils in schools received positive chatbots.

While more accomplished students were disinterested in the system, fewer accomplished students enjoyed using it (Nabiyev et al., 2013). However, the majority of academics assert that AI can improve student performance—but only if teachers are actively involved in the teaching and learning process. Additionally, raising classroom instruction standards and applying AI technology can significantly reduce apathy among pupils. They have proven successful in determining students' learning status, providing academic assistance to teachers and program officials, and ultimately reducing the number of students who drop out (Villegas-Ch. et al., 2021).

H1: There is a positive relationship between AI use and student learning academic outcomes.

Student Engagement

Teachers who have used technology, innovative teaching strategies, and student-centred approaches have facilitated active learning and engagement. Active education students succeeded in their academics. Classroom interactions, critical thinking, and the application of practical information (Lee & Hannafin, 2016) enhanced engagement. Social contracts and additional activities improved classroom engagement. These elements have strengthened students' sense of community and fostered personal development (Kuh, 2009). Hwang et al. (2020) identified the role of artificial intelligence (AI) in promoting student engagement across behavioural, cognitive and emotional dimensions. Artificial intelligence plays roles as tutors, advisors, partners, regulators and tutees (Chen et al., 2025; Hwang et al., 2020). Artificial intelligence, which serves as a tutor, includes AI-based platforms such as virtual classrooms and digital games that help instructors engage students emotionally and cognitively through personalised instructional support and adaptive feedback, guiding them in problem-solving and creative learning. Liu and Yushchik (2024) reported that there was a high reliance of college students on ChatGPT to acquire content and receive feedback (Chen et al., 2025; Liu & Yushchik, 2024). Moreover, AI serves as an advisor. AI intelligent tutors combined with personalised assessment tools powered by neural networks and BERTs detect nonlinear relationships and latent patterns in vast quantities of unstructured, sequential, contextual and high-dimensional learning process data (e.g., forum discussions, chat logs and essays) for holistic assessment and feedback of students' engagement levels and cognitive development (Liu & Yushchik, 2024).

Technologies provide benefits for improving learning processes through engagement and interaction, improving soft skills, and encouraging collaboration while also lowering costs and risks for academic institutions (Moraes et al., 2023). Online discussions increase students’ sense of belonging to a

learning community in collaborative online learning environments (Shackelford & Maxwell, 2012). Moreover, online learning increases the yield of positive outcomes (Andersen, 2013).

The use of AI-enabled robots improved student engagement in mathematics, computer science, and physical education in K–12 and higher education institutions (Chiu et al., 2023). Students who performed less academically reported increased feelings of productivity and safety from interactions with AI robots and decreased feelings of shame. Furthermore, technology, such as autonomous scoring systems based on image and speech recognition technologies, has increased the engagement of language learners (Fu et al., 2020). Game-based integration has been used in educational AI games to improve learning results and player engagement (Baker, 2019). Moreover, AI technology was used to create instructional content, provide professional advice to players, and alter the complexity of specific gameplay objectives (Baker & Ryan, 2019).

According to Hassan (2026), artificial intelligence use with structured guidance could increase engagement, which improves critical thinking, communication skills, and problem-solving, and it could improve overall performance. However, using AI without any guidance does not lead to positive performance and may negatively impact problem-solving in summative assessments. Engagement serves as a mediator in the relationship between AI integration and performance (Hassan, 2026).

H2: Student learning engagement mediates the relationship between AI use and student learning academic outcomes.

Personalised Learning Experience

Personalised learning is a learning design that adapts to meet the personal preferences, needs, strengths and purpose of individual students (Tapalova & Zhiyenbayeva, 2022; Walkington & Bernacki, 2020). For personalised learning, the teacher has a role in guiding students to manage the learning process and set and implement educational goals that meet their personal interests and needs (Aberbach et al., 2021). It is also important to motivate students' learning and promote their academic performance (Tapalova & Zhiyenbayeva, 2022; Zlatarov et al., 2021). Personalised learning focuses on personal growth and the learning environment. Tailored services, learning tools, or applications create a personalised learning environment that meets individual needs. Adaptive systems were used to fit individual learners' needs that focus on specific topics (Klašnja-Milićević & Ivanović, 2021; Tapalova & Zhiyenbayeva, 2022).

Artificial intelligence provides the needs of different groups, such as those of age, academic level and socioeconomic background, to increase learning experience and academic achievement. Artificial intelligence plays a role in developing personalised learning pathways. AI allows instructors to apply different teaching methods that are effective for each student. Artificial intelligence and machine learning are beneficial for educators in offering educational programs to students via an immersive virtual environment (Duggan, 2020; Tapalova & Zhiyenbayeva, 2022).

Digital technology can influence access to information and interaction with others. This digital revolution has led to the integration of digital culture into educational programs worldwide. Furthermore, learning management systems (LMSs) facilitate students' access to and engagement with learning materials. The traditional textbook has been replaced with tablets, incorporating diverse learning tools such as Google Classroom, Edmodo, Power School, and Moodle into their teaching practices (Chassignol et al., 2018).

Artificial intelligence has changed education by enabling personalised learning experiences (Merino-Campos, 2025). According to Amin et al. (2023), artificial intelligence (AI) is used to deliver personalised content. AI was also used to suggest that technical innovations can directly enhance student course selection and learning experiences. When AI was used to tailor to individual student needs, it could help improve academic outcomes. Demartini et al. (2024) and Chan and Hu (2023) also confirmed that adaptive learning modules and generative AI increase engagement and performance (Chan & Hu, 2023; Merino-Campos, 2025). AI-driven solutions could have the potential to improve personalised learning. The

use of artificial intelligence could enhance learning efficiency. It also modifies educational content, which offers opportunities to increase student engagement and performance (Merino-Campos, 2025).

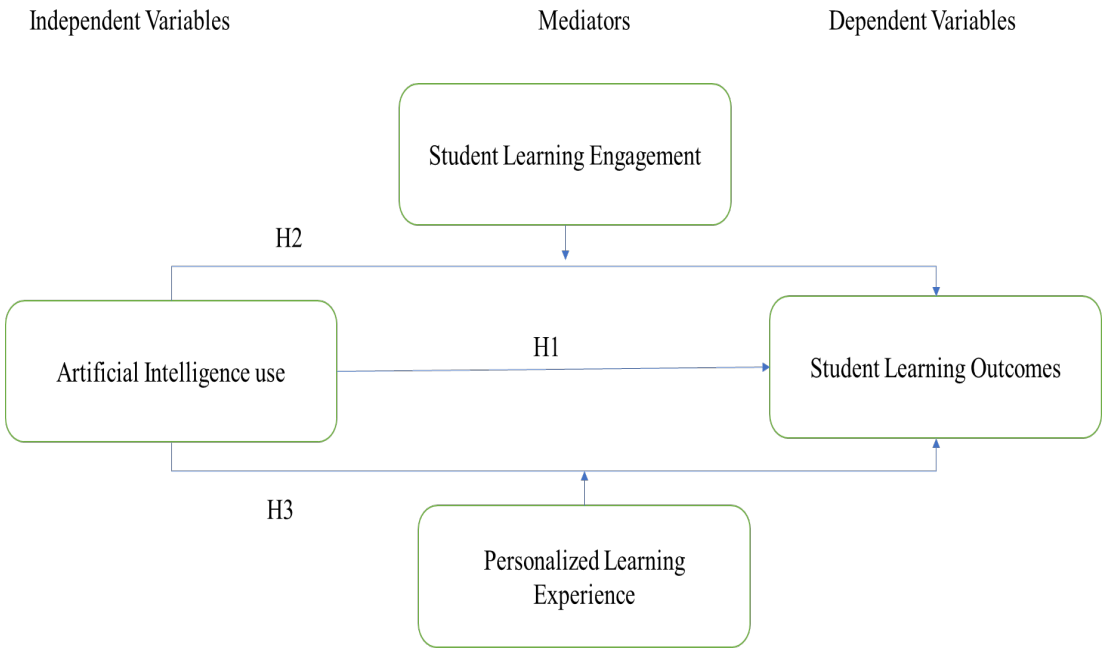
Artificial intelligence plays roles such as facilitating the establishment of personalised learning experiences. Adaptive learning platforms adjust content difficulty and pace based on individual performance (Demartini et al., 2024; Hooda et al., 2022). Moreover, intelligent tutoring systems provide real-time assistance and feedback to students. This guides students through coursework, elucidating concepts and enhancing comprehension and retention. AI is used to grade assignments, quizzes, and streamlined exams. This AI use enabled educators to focus on delivering personalized feedback and engaging with their students. AI was used to analyse learning data, such as student performance, to identify trends and patterns. These results are important for educators to refine curriculum design, identify struggling students, and implement timely interventions (Demartini et al., 2024).

Virtual labs and simulations were important for students to conduct experiments and investigate complex situations. AI-powered apps provide personalised instruction, pronunciation feedback and virtual conservation practices. AI algorithms provide important resources such as articles, videos, and books, which are interesting for students. Artificial intelligence automates tasks such as data analysis, literature reviews, and hypothesis generation (Demartini et al., 2024).

H3: Personalised learning experience mediates the relationship between AI use and students' academic learning outcomes.

Figure 1

Research Framework



Note. Adapted from Chiu et al., 2023; Moraes et al., 2023; Chassignol et al., 2018

RESEARCH METHOD

The study was conducted with students from a private university in Siem Reap Province in Cambodia. Mixed methods (quantitative and qualitative approaches) were employed in this research. Stratified random sampling for the quantitative approach was employed to ensure accurate representation of students from associate degrees, bachelor's degrees, and master's degrees, while purposive sampling was used to select respondents for the qualitative data. The population of this study consisted of students from a single private university located in Siem Province. The subgroups were divided based on the level of their studies: associate degree, bachelor's degree, master's degree, and PhD degree.

In this study, a quantitative method was used. An online survey with both closed-ended and open-ended questions was created. The questionnaires were subsequently distributed to selected classes of 200 students. The answers to the questionnaires on AI use, engagement, personalised learning, and academic success were given on a Likert scale ranging from 1 to 5 (1=strongly disagree, and 5=strongly agree). Finally, 192 respondents completed the questionnaire with sufficient information. The qualitative data were collected from 13 out of a total of 200 respondents.

An ethical standard was applied in this study. The research objectives were explained to participants, along with confidentiality. Before the data questionnaire was completed, the participants provided consent in advance. The personal identities of the respondents were not collected and are not shown in the report. Moreover, the collected data were stored on a computer in a safe place so that the data could be kept confidential.

The artificial intelligence usage questionnaire items were taken from (Vong Garrel & Mayer, 2023). With respect to the dependent variable sections, the student engagement variable's items were taken from (Xu et al., 2023). Cheng et al. (2023) identified the items for personalized learning experience (Cheng et al., 2023), whereas Pacheco-Mendoza et al. (2023) identified the items for the student's academic performance variable (Pacheco-Mendoza et al., 2023). Reliability was tested using Cronbach's alpha to assess internal consistency (Anshori & Aquino, 2026; Tavakol & Dennick, 2011).

The collected data were analysed using SPSS. This research utilised descriptive and inferential statistical tools in SPSS. Descriptive statistical tools, such as frequency and percentage, were used to describe the demographic data. Moreover, multiple regression analysis using the Andrew Hayes Process Model 4, which includes two mediations, was conducted to assess the relationship between artificial intelligence use and learning outcomes, as well as the mediating effects of personalised learning experiences and student engagement on the relationship between digital technology use and student academic outcomes (Hayes, 2013; Riznika & Kaihatu, 2021).

RESULTS

Reliability

Table 1
Reliability Test

Categories	Numbers of Items	Cronbach's Alpha
AI Use	9	0.958
Learning Engagement	6	0.934
Personalised Learning Experiences	6	0.945
Learning Outcomes	9	0.961

Note. Author, 2026

The reliability analysis results indicate that all the constructs in the study demonstrate excellent internal consistency, with Cronbach's alpha values exceeding the commonly accepted threshold of 0.7. Specifically, AI Use (α = 0.958), Learning Engagement (α = 0.934), Personalised Learning Experiences (α

= 0.945), and Learning Outcomes (α = 0.961) all show very high reliability, suggesting that the items within each category consistently measure their respective constructs. These high alpha values support the robustness and dependability of the survey instrument, making it suitable for further analysis.

Demographic Profile of the Respondents

The demographic data present the gender balance that contributed to this research and reflect the gender balance in university learning. Females made up 52% of the respondents, while males accounted for 48%. The majority of participants held a bachelor's degree (74%), while a smaller proportion had completed a master's degree (15%) or an associate's degree (11%), and only 1% possessed a PhD. Most of the respondents held a bachelor's degree, reflecting the high proportion of bachelor's degree holders among the students at the university where the study was conducted. The respondents from the business management major accounted for 46% of the total respondents, making them the largest group. Among the respondents, 17% were science and technology majors, and 13% were engineering and architecture majors. Most students in private schools studied in other areas, such as humanities and language (11%), law and social science (8%), and tourism and hospitality (5%), while majoring in business management. The contribution of this study was influenced by the students from the business major. The age distribution was also linked to the degree to which they held. As most of the students in private schools had bachelor's degrees, their ages were mostly between 21 and 25 years. In this study, the largest group, aged 21–25 years, accounted for 44% of the sample. This age group was followed by 15–20 (30%) and 26–30 (14%).

Table 2

Demographic Data

Demographic	Percent
Sex	
Males	48%
Females	52%
Education	
Associate	11%
Bachelor	74%
Master	15%
PhD	1%
Majors	
Business Management	46%
Engineering and Architect	13%
Humanity and Language	11%
Law and Social Science	8%
Science and Technology	17%
Tourism and Hospitality	5%
Age	
15-20	30%
21-25	44%
26-30	14%
31-35	8%
36-40	2%
41-45	1%

Note. Author, 2026

Artificial Intelligence Use for Learning

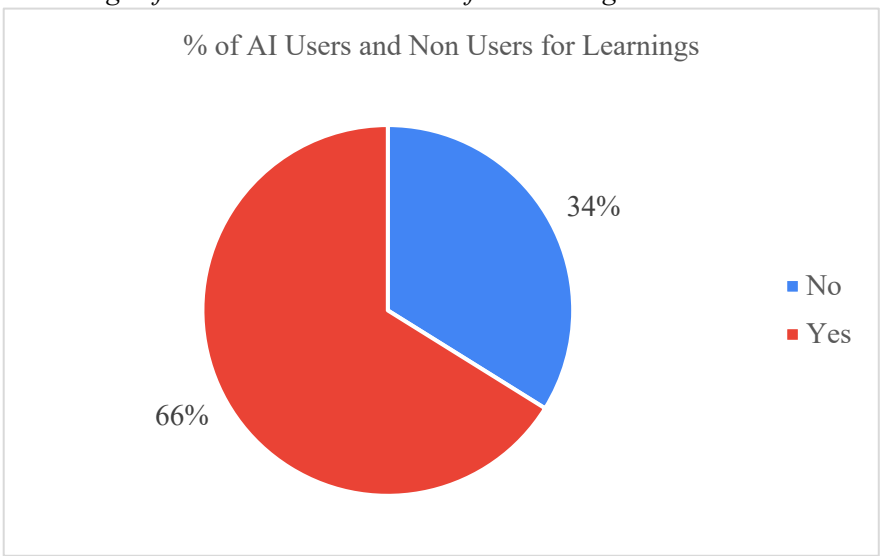
1. Artificial Intelligence Use for Learning

As shown in Figure 2, 66% of the respondents reported using artificial intelligence (AI) for learning, whereas 34% reported not using AI in their learning. This suggests that AI tools—such as ChatGPT, translation apps, or educational platforms—have become relatively widespread among the sample population, with two-thirds incorporating them into their study practices. However, the one-third who do not yet use AI highlights that a considerable number of learners may lack access, awareness, or the willingness to adopt AI in their educational routines. This split may warrant further exploration into the reasons behind non-usage, such as digital literacy, perceived usefulness, or trust in AI technologies.

The percentage of students who used artificial intelligence was similar to that in a study with more than 6300 students across Germany, which revealed that almost two-thirds of students used AI-based tools for their learning. Among the AI tools, almost half of the students used ChatGPT or GPT-4. Students in engineering sciences, mathematics, and natural sciences have primarily used AI (Vong Garrel & Mayer, 2023).

Figure 2

Percentage of AI Users and Non-Users for Learnings

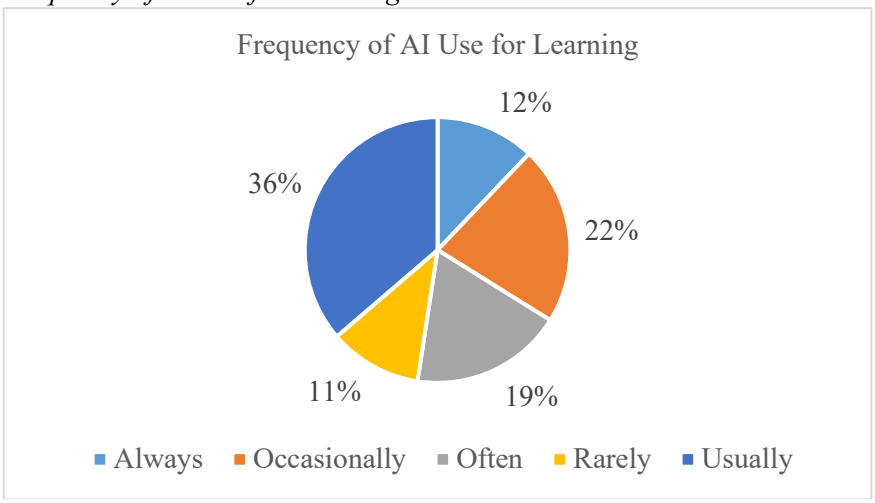


Note. Author, 2026

The frequency of artificial intelligence (AI) use for study purposes revealed varied patterns of engagement among the respondents (Figure 3). The largest proportion, 36%, reported that they usually use AI in their studies, indicating a high level of regular, but perhaps not constant, integration of AI tools in their learning routines. This is followed by 22% who use AI occasionally and 19% who use it often, suggesting that while AI is commonly used, its intensity and consistency of use differ among learners. Twelve percent (12%) of the respondents stated that they always rely on AI for study purposes, indicating a small but committed group that consistently integrates AI into their academic activities. On the other hand, 11% use AI rarely, reflecting either a limited need for such tools, lower digital engagement, or potential barriers to access or trust. Overall, the data suggest that AI has become a significant component of many students' learning strategies, with varying frequencies depending on individual preferences, study habits, or academic requirements.

Figure 3

Frequency of AI Use for Learning



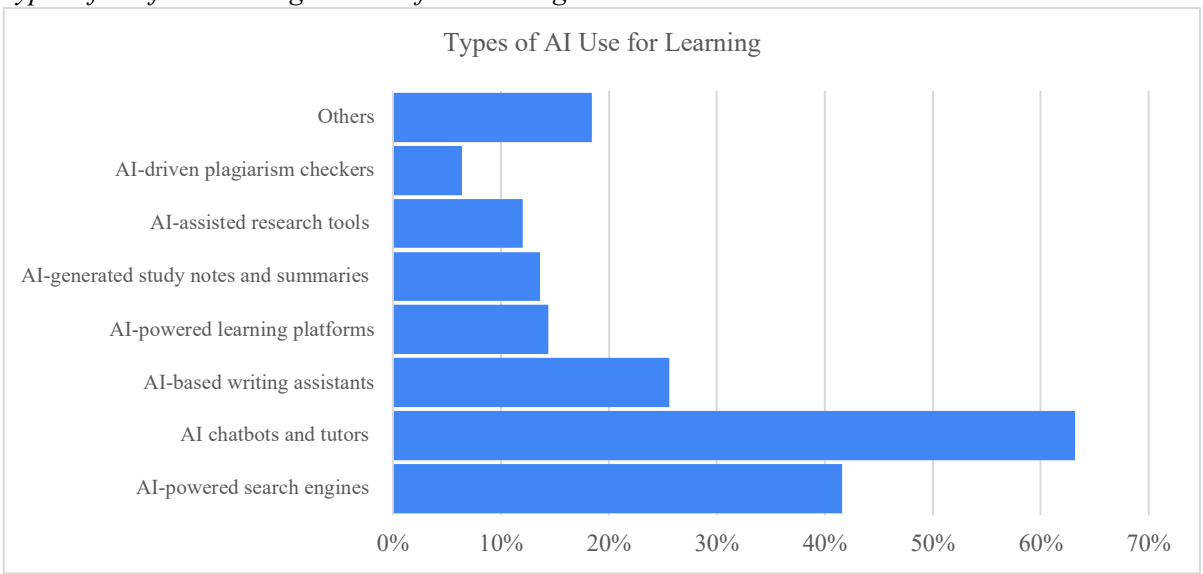
Note. Author, 2026

2. Types of AI Uses for Education

Figure 4 focuses on the types of AI used for study purposes and indicates that AI chatbots and tutors were the most commonly utilised tools, with 63% of the respondents reporting their use. This suggests a strong preference for interactive, conversational AI systems—such as ChatGPT—that can provide explanations, answer questions, and support personalised learning. AI-powered search engines were used by 42% of the respondents, highlighting the role of AI in enhancing information retrieval and improving research efficiency.

Figure 4

Types of Artificial Intelligence Use for Learning



Note. Author, 2025

AI-based writing assistants were employed by 26% of the participants, reflecting their usefulness in improving writing quality, grammar, and coherence in academic work. Less commonly used tools include AI-powered learning platforms and AI-generated study notes and summaries (both at 14%) and AI-assisted research tools (12%). These relatively lower percentages may reflect either limited awareness of such tools or their specialised applications in certain fields. AI-driven plagiarism checkers were the least used (6%), suggesting limited concern about plagiarism among users or integration into broader platforms, where they are unrecognised as separate AI services. Sol et al. (2024) reported that AI-powered tools were used by Cambodian university students, including Grammarly, to assist them in translating languages and checking for grammatical errors, thereby accelerating their language acquisition.

Relationships between AI Use and Student Learning Outcomes

H1: There is a positive relationship between AI use and student learning academic outcomes.

Table 3

The relationship between AI use and student learning academic outcomes

Effect	se	t	p	LLCI	ULCI	c_cs
.638	.065	9.834	.000	.509	.766	.668
R=.668						
R-sq=.446						
P=.000						
β=.668						

Note. Author, 2025

The data in Table 3 show that the use of artificial intelligence positively influenced students' academic learning outcomes. The total effect is significant (p=0.00). Without any control, AI use could strongly protect academic learning outcomes (R = 0.668). AI use explained 66.8% of the variance in academic learning outcomes (β = 0.668). The results of the current study are in line with those of several other studies. An adaptive learning system was used to detect gaps in knowledge and intervene to address their learners' needs, which led to positive effects on their academic performance (Saleem et al., 2025). An adaptive learning system helps students understand core concepts and then become more advanced in more complex subjects. The system helps students minimise the learning differences among various learners. Moreover, AI helps instructors differentiate instruction by modifying the difficulty of assignments. AI can enable differentiated instruction by modifying the level of difficulty in assignments. AI could help in analysing real-time performance, providing support to struggling students. Moreover, AI helps learners explore more advanced material (Wood, 2018; Saleem, Aziz, Iqbal, & Abbas, 2025). Even positive impacts of AI on academic learning outcomes have been reported, but these effects require some consideration, such as effective application, the availability of good-quality learning content, and teachers' engagement (Saleem et al., 2025). Sol et al. (2024) reported that the application of AI-powered tools maximised students' personalised learning experience because AI-powered tools were used to assist them in translating languages and checking grammatical errors, thereby accelerating their language acquisition. Moreover, the study indicated that students are willing to leverage AI tools (e.g., Google Translate, Grammarly, ChatGPT, and Quill Bot) in their English language learning (Sol et al., 2024). Heng (2023) reported that AI tools should be used to search for general information, assist with assignments or homework, and ask for timely and constant feedback (Heng, 2023). Therefore, teachers can work on other important tasks associated with teaching and learning quality improvement (Sol et al., 2024).

In addition to the benefits, some studies have raised concerns about the use of AI applications, including privacy and security risks. The utilization of AI has also led to a decline in critical thinking, creativity, academic integrity, assessment challenges, and the dissemination of false and biased information (Pum & Sok, 2024).

H2: Student learning engagement mediates the relationship between AI use and student learning academic outcomes.

Table 4

Mediation between learning engagement and the relationship between AI use and student learning academic outcomes

Path	Effect	se	t	p value	LLCI	ULCI	c-cs
Total Effect	0.638	0.065	9.834	0.000	0.509	0.766	0.668
Direct Effect	0.368	0.092	4.008	0.000	0.186	0.549	0.385
Indirect Effect	Effect	Boot SE			Boot LLCI	Boot ULCI	
ENG	0.270	0.098			0.080	0.487	

Note. Author, 2025

The data in Table 4 confirm that AI use has an overall impact on academic learning outcomes (B=0.638, p=0.00). After accounting for engagement, artificial intelligence (AI) use still has a positive effect on academic learning (B=368, p=0.000). This means that AI use could have direct and indirect effects on academic learning outcomes. AI use improved student engagement, which in turn led to better academic learning outcomes. The confidence interval does not include zero (Boot LLCI=0.080, Boot ULCI=0.448). This finding indicates that student learning engagement partially mediates the relationship between artificial intelligence use and academic outcomes.

Respondent 6 used ChatGPT to explore information and acquire new knowledge. Moreover, ChatGPT helps design lessons, exercises and course materials. It also helps translate from English to the Khmer language. When he uses ChatGPT, he gains knowledge, and then he contributes this knowledge in group discussions, which makes the group more active and allows him to share his knowledge with the whole class. ChatGPT could simplify complex subjects and explain them to him any time he needed (Interview, June 13, 2026).

Respondent 8 used AI for her learning, and it positively affected her study results. She obtains better results when she uses AI for learning. By using AI, she could explore new information and learn new things. She also uses AI to help her prepare for exams. For example, lecturers have given pre-examination questions to students. She could use AI to answer these questions. With support from AI in preparation for the exam, she could do the exam with better results (Interview, June 14, 2026).

According to respondent 10, AI can help with learning in many ways, such as understanding lessons, explaining difficult concepts, providing writing assistance, helping to prepare ideas for articles, reports or research, learning a foreign language, translating words or sentences, solving exercises, creating test questions, summarising documents, assisting in research and managing learning. The use of AI has largely responded to the need for rapid information retrieval, solving complex questions and accelerating research in our studies. AI helps her explain complex exercises and theories: AI facilitates a more profound understanding by explaining difficult concepts. When she does not understand economic theory or mathematical formulas, she can have AI explain them in Khmer by converting them into simple everyday examples. AI assists her in teaching and practising foreign languages. AI can correct her grammar and suggest new, better keywords for her to improve. Using AI can greatly enhance relationships with friends and teachers in terms of learning by facilitating more effective collaboration and communication. AI acts as a facilitator and generates new ideas for group learning. AI can help improve learning outcomes if used correctly and responsibly, as AI helps students find information and knowledge quickly, explains difficult lessons in an easy-to-understand way, helps with exercises and provides step-by-step instructions, creates practice questions and lesson summaries, and helps with study planning and time management (Interview, June 14, 2026).

According to respondent 11, she has used AI such as ChatGPT, Google Gemini and Grammarly. AI helped her achieve better results, as it explains lessons that are difficult to understand, saves documents and long texts, finds references and information online, prepares a lesson or saves 7 new words with their meanings, promotes communication and collaboration and solves difficult questions. She has obtained

better results when she asks for assistance from AI for learning. However, some constraints were faced as well. For example, the information or answers given were not accurate at 100%. It is necessary to have knowledge to validate it (Interview, June 14, 2026).

Respondent 12 used AI, such as Gemini, ChatGPT and AI modes. AI helps fill in gaps and accelerate the understanding of lessons according to individual needs, as it explains unclear points immediately, summarises long texts, and creates practice exercises. For example, when she does not understand a statistical formula or mathematical equation, she lets AI help break the exercise down into steps (step-by-step), which is easier to understand than reading a general book alone. AI can be a bridge and strengthen relationships very well, as AI helps generate new ideas for group work. When doing group work, she can let AI help prepare the project outline and clearly discuss and divide the work with friends. The use of AI helps to contribute to better learning outcomes if it is used as a learning aid, not to plagiarise or have it do the work entirely (Interview, June 14, 2026).

Respondent 13 uses AI for learning, including ChatGPT, Google Gemini, and Google AI Mode, as it helps her find information quickly, explain lessons, and support research. It can also translate into other languages. Example: When she studied English, she found some difficult words, so she used AI to translate and solve her questions. Using AI contributes to better learning outcomes because it helps her when she has questions or wants more information. It makes it easy to locate documents quickly (Interview, June 13, 2026).

The findings of Swargiary (2024) support the current research, identifying engagement as a key driver of learning success. Moreover, an AI-based personalised learning system is a tool for increasing student engagement and motivation. In comparison with conventional classrooms, AI use could help with personalised attention, which is a gap in conventional classrooms because AI can be used in learning, such as gamification, virtual simulations, and adaptive quizzes, making learning more fun and interactive (Saleem et al., 2025; Swargiary, 2024).

The findings of the current research are also consistent with those of Plooy et al. (2024). According to his research, some kinds of artificial intelligence, such as AI-driven chatbots and virtual tutors, could provide feedback and tailored assistance. The use of this AI tool has motivated students to actively participate in their learning process without feeling lost or demotivated. Moreover, AI use can increase intrinsic motivation among students, as it helps them adopt education more self-directedly (du Plooy et al., 2024). However, the balance between AI-facilitated interactions and human interactions should be considered. Therefore, technology could support teaching rather than substitute for conventional teaching techniques (Bhatia et al., 2024; Saleem et al., 2025).

These findings contradict those of Shamsudin and Cao (2025). Their research confirmed that student learning engagement did not mediate the relationship between technology readiness and student academic performance. Their study revealed that student learning engagement mediated the relationship between machine learning (ML)-enabled personalised learning and student academic performance. These findings confirm the important role of engagement as an intermediary in enhancing academic outcomes in ML-driven learning environments (Shamsudin & Cao, 2025). AI integration into education enhances student engagement, performance, and self-efficacy, leading to successful outcomes (Baikulakov et al., 2026; Medina-Gual & Parejo, 2026). AI tools help students build confidence in the learning process, particularly in subjects that require visual skills (Baikulakov et al., 2026; Hare et al., 2025; Medina-Gual & Parejo, 2026). Sampah et al. (2026) confirmed that generative AI is important for competence, learner autonomy, and that AI utilization shapes student engagement and learning experiences in higher education (Duc, 2026; Sampah et al., 2026).

Another study supports this research by finding a significant association between AI use and student engagement. The results revealed a moderate association, with $r = 0.614$ ($p < 0.01$) (Moraes et al., 2023). Innovative assessment methods and pedagogical approaches fostered student engagement and improved the quality of education. Furthermore, Sok (2023) reported that AI-powered tool use can help

Cambodian teachers enhance assessment and pedagogical practices by creating innovative tests and designing engaging lessons for teaching (Sol et al., 2024).

Artificial intelligence was used by teachers to design lessons that meet students' learning needs, establish a smart context, and automatically grade tests, as well as provide automated tutoring and categorize learning difficulties (Soun, 2023). Teachers use AI to search for general information, design course syllabi and lessons, and create classroom content (Heng, 2023). Several tasks were developed using AI-driven tools, including generating codes, producing quizzes and exams, and detecting plagiarism (Kiripost., 2023). Furthermore, artificial intelligence was employed to respond to student enquiries and to create lesson plans, exercises, quizzes, and educational materials. It can also be utilized for evaluating students' writing, providing consistent and prompt feedback, and identifying diverse levels of knowledge among students (Jeganathan, 2023).

This study is also similar to the one by Tieng et al. (2023), which confirms the positive relation between peer-group interaction and academic and intellectual development (Tieng et al., 2023). Furthermore, this study was consistent with the suggestion that students who have better peers tend to improve their own academic performance (Tinto, 1994).

H3: Personalised learning experience mediates the relationship between AI use and students' academic learning outcomes.

Table 5

Mediation between learning experience and the relationship between AI use and student learning academic outcomes

Path	Effect	se	t	p	LLCI	ULCI	c-cs
Total Effect	0.638	0.065	9.834	0.00	0.509	0.766	0.214
Direct Effect	0.205	0.100	2.057	0.042	0.008	0.402	0.214
Indirect Effect	Effect	Boot SE			Boot LLCI	Boot ULCI	
PLE	0.433	.090			.245	.607	

Note. Author, 2025

The data in Table 5 confirm that AI use has overall positive effects on academic learning outcomes (p=0.00). After accounting for personal learning experience, AI use also positively predicted academic learning outcomes (p = 0.042). This finding could be explained by the fact that AI use has positive direct and indirect effects on academic learning outcomes. The confidence interval does not include zero, as it ranged from 0.245 to 0.607. This finding indicates that AI use could partially mediate the ability of AI use to predict academic learning outcomes.

Respondent 1, a male student, has used Canva to develop and design slide presentations of their assignments, which are required to be present in class. A slide presentation created with Canva was more engaging for the audience than presentations made with non-Canva tools were. Moreover, slide presentations with Canva assistance were faster and saved time (Interview, June 13, 2026).

Respondent 2, a male student studying for a bachelor's degree, used Gemini to receive feedback and consultation. Teachers did not become stuck on the questions they asked. He has used Gemini, and it provides information with sources. He subsequently clarified the situation and selected the best answers to respond to the teachers. When he uses Gemini for assistance and feedback, his learning scores generally improve. When Gemini was used to assist in learning and obtaining course materials, it could reduce the degree of connection with other students (Interview, June 13, 2026).

Respondent 4, a male student, has used Gamma to develop slide presentations for doing assignments given by the teacher. He could design a slide presentation with Gamma fast to meet his needs. By using Gamma, he could manage presentations timely and effectively (Interview, June 13, 2026).

Respondent 5, a female student, used a grammar checker to verify her English grammar when writing in English. When she wrote in English, she felt that her English was satisfactory and correct. She used a grammar checker to review her English. There are some corrections. She could learn from that and improve her English. She has also confirmed that with support from the grammar verification tool she has used, her English score has improved (Interview, June 13, 2026).

The respondents (1-5) used Google Translate or Gemini to translate English text to Khmer text so that they could understand it, as the teachers mostly provided lectures or case studies in the English language for analysis. These students were hard pressed to capture the meaning of English text. With the assistance of Google Translate and Gemini, this English text was translated into the local language, which could be understandable even if the English language skills of the English-speaking students were limited. These tools could help them learn faster and more effectively (Interview, June 13, 2026).

Respondent 9 used a number of AIs, such as ChatGPT, Gemini, Grammarly, and Perplexity, for his learning. ChatGPT helps explain complex subjects, whereas Grammarly helps verify grammar and correct incorrect English words. Perplexity AI was used to identify the credit sources of the documents. AI also contributed to deeper collaboration with friends for learning. For example, in class, a group discussion was formed to perform the assignment given by the lecturer. They used AI to search for data and information. The data and information are beneficial because they provide knowledge that he can use to discuss and debate in a group (Interview, June 14, 2026).

The findings of the current study agreed with those of several previous studies. For instance, Ellikkal and Rajamohan (2024) confirmed the use of AI-powered personalised learning systems to assess students' prior knowledge, learning pace, and interests. The assessment results could help teachers provide dynamic content with adjustments in real time (Ellikkal & Rajamohan, 2025; Saleem et al., 2025). This system employs diverse methods, including adaptive testing, predictive modelling, and recommendation systems, which can help with personalised exercises, multimedia content, and immediate feedback. Learners can progress based on their understanding of AI-based personalisation. This helps learners minimise frustration and maximise an efficient learning process. Artificial intelligence (AI) was used to assess students' thought processes and help teachers take the best actions for better teaching (bin Salem, 2024; Saleem et al., 2025). Saleem et al. (2025) confirmed that the use of AI-based personalised learning could improve student performance measures, including knowledge retention and problem-solving ability, as well as overall student achievement (coefficients ranged from 0.68 to 0.75). Moreover, there was a correlation between knowledge retention and problem-solving capacity. AI-based personalised learning helps students improve their cognitive function.

AI-driven technologies influence student engagement through multiple pedagogical mechanisms, including personalised learning, real-time feedback, gamification, resource accessibility, affective comfort, and contextual adaptability. Artificial intelligence (AI) facilitates personalised learning by analysing student behaviour and cognitive data to provide feedback for individualised learning strategies. The system could increase motivation and active participation (Long et al., 2026). For example, a cloud-based K-means clustering system was used for Chinese instruction, which increased student engagement (Long et al., 2026; Shang, 2024). Another example was that the Spark-based recommendation model was used to align content to meet the learners' needs. These methods could increase the acquisition of knowledge and the participation of students (Liu & Yushchik, 2024; Long et al., 2026). In addition, students use adaptive platforms such as Smart Sparrow, and their use of these platforms improves student engagement by 96% (Linden et al., 2019; Long et al., 2026). Moreover, the integration of the use of predictive models and learning analytics further promoted collaboration in online environments (Long et al., 2026; Ouyang et al., 2023).

Hutchins (2017) demonstrated that artificial intelligence was used to create personalised educational materials designed to address the specific requirements of each student, enabling adjustments in learning speed and comprehension level (Hutchins, 2017). Moreover, the use of AI tools facilitated personalised learning. Cambodian students have a better chance of developing autonomous learning skills,

which are necessary for 21st-century education (Sol et al., 2024). AI-powered applications were used to analyse students' learning styles, interests, and strengths and to customise the content and pace of instruction to meet their varying needs (O'Connell, 2024). Generative AI tools are used for various academic purposes, such as assessment feedback, research assistance, administrative communication, and curriculum design. This AI use requires responsible-use frameworks to address accuracy, privacy, authorship, accountability, and research integrity (Smith et al., 2026; Tan & Teoh, 2026).

Ellikkal and Rajamohan (2025) confirmed the alignment of their findings with the current research, which revealed the relationships between student engagement and academic learning outcomes. Ellikkal and Rajamohan (2025) suggested that AI-powered learning is vital for improving student learning outcomes. This means that when students use AI-powered tools for their learning, their academic learning outcomes can improve. However, their study did not analyse the direct relationships between AI use and academic learning outcomes. The study revealed that there was a relationship between AI-powered learning with competence, autonomy and relatedness; the relationships between these three constructs and student engagement; and the relationship between study engagement and academic learning outcomes.

DISCUSSION AND CONCLUSIONS

This study aims to analyse the effects of AI use on student learning and academic outcomes, as well as the mediating effect of personalised learning experiences and engagement in their relationship. Three hypotheses are tested: There is a positive relationship between AI use and students' academic learning outcomes, and student learning engagement partially mediates the relationship between AI use and academic learning outcomes. Personalised learning experience also plays a role in partially mediating the relationship between AI use and academic outcomes.

IMPLICATIONS

The current research expands and validates the theory of constructivism, originally attributed to Lev Vygotsky in 1978 (Amineh & Asl, 2015). The constructivist learning theory constructs, including personalisation and engagement, are operationalised in an artificial intelligence context. Artificial intelligence use has positive effects on learning outcomes. It provides empirical evidence to explain how AI constructs knowledge, which validates and supports constructivist theory.

This study is important for universities and higher education institutions, as they develop strategies to mainstream AI use in their policy development. Moreover, it is vital for policymakers to develop and implement policies more effectively to promote AI use in education. Artificial intelligence tools should be integrated into universities to enhance student interaction, motivation, and collaboration. The AI used by students can create better learning environments, encourage active engagement, and improve academic performance. Students should receive clear guidance on how to use AI. Training courses on AI use and AI ethics should be provided for students. AI training effectively increases knowledge of AI and helps students use it ethically in their learning.

There were negative effects on students' analytical and problem-solving abilities when students were over-reliant on AI. Therefore, educational institutions should use both AI-driven learning and conventional educational methods to support cognitive development and interpersonal engagement. Finally, a long-term study on AI use and its effects on student learning outcomes should be conducted. Moreover, this study should be scaled up to broader populations. The current study analyses the relationship between AI use and academic learning outcomes, as well as the mediating effects of engagement and personalised learning experience on this relationship. Therefore, this research should be extended to include an analysis of the relationships between AI use and the competence, autonomy, and relatedness constructs, as well as how these three constructs are related to student engagement (Ellikkal & Rajamohan, 2025). A qualitative study on this topic should be carried out.

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