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Smart Learning in the Age of AI: How AI Influences Personalized Learning and Academic Performance Through Student Engagement

Daisy Mui Hung Kee[1], Wen Yi Tan[2], Syarifah Adlina Abdul Rahim[3], Pei Yi Tan[4], Zhi Wen Tan[5]
Universiti Sains Malaysia[1,2,3,4,5]
Jalan Sungai Dua, 11800 Minden, Pulau Pinang, Malaysia
Corresponding Email: wenyi27@student.usm.my

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ABSTRACT

The rapid advancement of artificial intelligence (AI) is reshaping teaching and learning in higher education by enabling more flexible and technology-enhanced learning experiences. This study examines how AI usage influences students perceived personalized learning and academic performance, with student engagement as a mediating mechanism. Drawing on a quantitative survey of 202 university students in Malaysia, data were analyzed using SPSS to test the proposed relationships. Our findings indicate that students actively use a wide range of AI tools, particularly generative AI chatbots and writing assistants, which are primarily applied to support exam preparation, assignment completion, and conceptual understanding. Our findings show that AI usage is positively associated with both personalized learning and academic performance. In addition, student engagement plays a mediating role in these relationships. Our study contributes to the emerging literature on AI in education by providing empirically grounded evidence from a Southeast Asian higher education context and by highlighting engagement as a key explanatory mechanism.

Keywords: artificial intelligence, student engagement, personalized learning, academic performance, higher education, Malaysia

INTRODUCTION

The emergence of Artificial Intelligence (AI) has made great impacts on modern education, particularly in terms of increasing the efficiency of accessing, processing, and engaging with learning materials. According to recent research, for example, Von Garrel and Mayer (2023), it has been noted that the use of AI technologies such as intelligent tutoring system and automated feedback has become crucial for facilitating students' learning processes, thus making them more efficient and flexible. Furthermore, due to the rapid emergence of the technology of generative AI, students now have more chances to get instant responses to any questions that can arise during their work as well as to receive necessary explanations, advice, and support from such programs as ChatGPT. The relevance of AI to the modern educational system is confirmed by another study, where Sabeh et al. (2025), in ChatGPT in the Malaysian Classroom: Assessing Student Acceptance and Effectiveness Through UTAUT2 and IS Success Models, note the positive response of students to using this technology and regard it as an effective method to enhance learning effectiveness and student satisfaction. "Therefore, this study explores the impacts of AI on student engagement and academic performance."

Furthermore, student engagement can be described as the extent of the student's involvement, participation, attentiveness, and motivation in engaging in educational practices. According to Xu et al. (2023), students with high levels of engagement would have high involvement in class interaction, completing assigned assignments, and being motivated throughout the learning process. The concept of student engagement can be measured through behavioral, emotional, and cognitive variables like attendance, enthusiasm, critical thinking ability, and willingness to engage in studying. With regards to the use of technology in learning, the use of artificial intelligence (AI) can help improve student engagement by ensuring prompt feedback, interactions, and assistance in the learning process. As seen from previous studies, for instance, by Sabah et al. (2025), AI tools such as ChatGPT have been positively accepted in learning practices, but there is less research focused on how AI affects student engagement and motivation in higher education, especially in Malaysia.

Moreover, AI is used as one of the key factors in developing personalization of learning experiences. Personalization of learning is understood as an approach to customize learning processes, styles, and even educational material depending on students' needs and preferences. In contrast to "one size fits all", personalization allows using artificial intelligence to identify students' peculiarities and create a personalized path of learning that will help improve knowledge acquisition and consolidation (Aizza et al., 2024). For instance, it is stated by Cheng et al. (2023), that personalization will allow students to study at their own pace and get appropriate feedback from tutors and peers. Adaptive technologies will make it possible to adjust educational material to students' needs, resulting in better efficiency and meaningfulness of the studying process.

Moreover, academic performance, which means the academic results attained by students, is another factor affected by the adoption of AI in the learning process. Academic performance can be enhanced by use of AI since it enables provision of immediate feedback, personal recommendations, and ongoing assessment, which enable students to better grasp concepts taught and hence perform well academically. Personalized learning environments and those supported by technology help to improve the performance of learners (Pacheco-Mendoza et al., 2023). AI tools also identify learning gaps and provide necessary interventions to enhance academic performance.

Even though much attention has been given to the topic of personalized learning and academic achievement, it should be noted that little is known about the process of their

influence on each other in the context of a technology-based learning setting. Previous research has studied the influence of Artificial Intelligence on the process of learning; however, there is a lack of knowledge regarding the interaction between these two variables concerning learners' engagement in the process of learning. Thus, there exists a gap in the literature that requires further exploration. Moreover, the growing implementation of technologies like ChatGPT in higher education makes researchers pay much attention to the influence of these technological advancements on the learning process and achievements of students. It is worth mentioning that despite the increasing number of studies in this area, there are limited amounts of investigations devoted to the effect of these variables in Malaysia.

Additionally, this paper also offers relevant practical insights for several entities in the realm of education. From the educator's point of view, knowledge about the impact of Artificial Intelligence on student engagement, personalization, and achievement will enable them to create more effective teaching strategies and learning experiences. At the same time, for institutions of higher learning, the results of the paper may help them in implementing AI technology in their curricula and learning environment. Moreover, even students may find themselves gaining from knowing the role that Artificial Intelligence plays in the improvement of the learning process through its use. On a theoretical level, the paper also contributes to the existing literature by combining different variables within one single model.

Hence, the objectives of this study are to investigate the relationship of Artificial Intelligence in learning, student engagement, personalized learning, and academic performance among university students. The inspiration behind the study is the increased use of AI technologies such as generative AI applications like ChatGPT in the education sector that has changed the way students learn and engage with learning materials. Although various studies have discussed the effect of AI individually on the learning outcome, not much literature has been published on the collective impact of all these variables within the same framework, especially among Malaysian students. It should be noted that the current research is unique in that it incorporates student engagement, personalized learning, and academic performance together in one study. As such, the research will provide meaningful insight into how AI can effectively influence learning outcomes in education.

LITERATURE REVIEW

Artificial Intelligence and Student Engagement

Artificial intelligence (AI) is used to enhance student engagement in education. AI tools like adaptive learning, intelligent tutoring systems and conversation chatbots make it easy to personalize. It also adapts materials to individual student's abilities and needs. This makes learning easier to understand and more interesting to students who are more likely to remain focused and actively engaged (Maamor et al., 2024; Kasneci et al., 2024). Additionally, studies indicate that AI has a positive impact on student engagement. For example, studies published in Education and Information Technologies found that using AI tools in education can significantly enhance students' behavioural, emotional and thinking engagement, increasing the involvement in learning activities (Hassan, 2026). According to a review, AI tools like learning analytics and intelligent feedback systems, help increase interaction and promote a more student-centered learning style (Long et al., 2026). Students' intention to participate in learning activities is greatly influenced by their attitude toward online classed, including their interest, positive feeling and readiness to participate (Ullah et al., 2022). AI also can track students' progress and give immediate feedback, helping teachers adjust their teaching

while maintaining students' motivation and interest (Wang, 2025). When AI tools also support group work and interaction, students become even more engaged in the learning process (Hendra et al., 2025). In the era of smart learning, AI tools play a crucial role in student engagement. Therefore, we propose:

H1: Artificial intelligence in learning has a significant positive effect on student engagement.

Artificial Intelligence and Personalized Learning

Artificial intelligence (AI) has gained widespread recognition as a powerful tool for improving personalized learning. Personalized learning means teaching strategies that are adjusted to fit each student's requirements and learning style. AI tools are made to modify learning content based on each student's unique skills, learning style and preferences. E-learning systems that adapt to students' needs and provide flexible learning experiences can enhance satisfaction by supporting more personalized learning (Fozeli et al., 2022). This allows students to study in a more flexible and suitable way, making difficult subjects and improving their overall educational experience (Maamor et al., 2024; Kasneci et al., 2024). Recent studies further support the importance of AI in creating customized learning environments and quickly analyse students' data. For example, a study found that AI-based-system in higher education may modify course materials and provide personalized feedback to enable students to study more effectively based on their individual needs (Hassan, 2026). Another example, AI systems might identify students' areas of weakness and offer more practice or simpler explanations to help me get better. In addition, research also shows that AI tools like learning analytics help teachers in monitoring students' progress and give assistance (Wang, 2025). Therefore, students are leading a better learning outcome by using AI tools for personalized learning. Hence, we propose:

H2: Artificial intelligence in learning has a significant positive effect on personalized learning.

Artificial Intelligence and Academic Performance

Artificial intelligence (AI) has become an important tool in modern education, especially in enhancing students' academic achievement through smarter learning systems. Students can learn at their own pace and understand content more successfully by using AI tools. AI helps analyze students' data to adjust specific learning ways according to their learning needs. This strategy promotes improved academic results and reduces learning gaps. According to recent research, AI-based learning systems can enhance academic performance by providing timely feedback, providing learning support and identifying weak areas (Wang, 2025; Ikram et al., 2026). Additionally, AI tools assist teachers tracking students' progress and intervening early when they face problems and improve performance outcomes (Hendra et al., 2025). Besides, AI improves learning efficiency by making complex topics through interactive learning and customized explanations. Research also shows that students' academic performance tends to rise when they are more engaged in AI-supported learning environments (Long et al., 2026). In study of Furze et al. (2024), students' grades and passing rates increase by using AI tools in an organized manner, demonstrating its direct influence on academic success. As such, we hypothesize:

H3: Artificial intelligence in learning has a significant positive effect on academic performance.

Student Engagement and Personalized Learning

There is consensus among scholars that student engagement is one of the most important elements for improving learning efficiency and results. Student engagement is defined as the extent to which learners are involved in learning-related activities through their behavioral, cognitive, and emotional participation. Engagement is an essential aspect in modern education research as it is considered to be one of the main catalysts of meaningful learning since it shows how the interaction with learning materials happens. For example, a systematic study conducted by Johar et al. (2023) shows that higher levels of student engagement positively impact learning performance and results. Personalized learning is an approach to learning that considers specific needs, preferences, and individual features of learners when designing educational experience. Khor and K (2024) notes that personalized learning improves learner motivation and academic results by considering the specific characteristics of each learner. Such an approach can help the learner become more engaged because of the relevance of the information they have access to during education. There is ample evidence from previous literature showing how the connection between engagement and personalized learning works. Engaged students are likely to be involved in personalized learning contexts. Student engagement is a crucial factor that significantly influences improved personalized learning plans, as the greater the level of student engagement, the higher the learning achievements. Moreover, according to Hu and Kee (2022), a harmonized digital and flexible learning environment implies the continuous involvement and interaction of learners in the learning process since those who engage in the process actively can utilize adaptive methods and personalized learning paths effectively. Hence, based on the findings discussed above, it can be suggested:

H4: Student engagement has a significant positive effect on personalized learning.

Student Engagement and Academic Performance

Academic performance can be considered as a basic criterion of the effectiveness of the learning process and is usually determined by means of grades, tests, and achievements. Many scientific works claim that student engagement plays an important role in student academic performance due to the fact that engaged students show great effort, perseverance, and comprehension of material. Student engagement positively influences the academic performance of students through various types. Students who are behaviorally engaged involve themselves in classroom activities and homework; those who are cognitively engaged make great efforts in comprehending difficult material. The findings of a systematic review conducted by Johar et al. (2023) reveal that student engagement plays a vital role in improving the academic performance of students in many educational settings. This has been proven empirically in multiple instances. For instance, based on the empirical findings presented in Karunaratne et al. (2025), it can be established that high student engagement is never associated with poor academic performance, revealing an extremely significant positive relationship between the two. Likewise, a study in the Hakim et al. (2025) reveals that engaging students in problem-based and project-based learning methods results in an improvement in students' academic performance. Furthermore, a personalized and interactive learning environment positively reinforces this relationship. For instance, according to Castro et al. (2024), personalized learning enhances both engagement and academic performance; thus, it can be assumed that engagement mediates learning performance.

H5: Student engagement has a significant positive effect on academic performance.

Conceptual Framework

The study framework model is depicted in Figure 1.

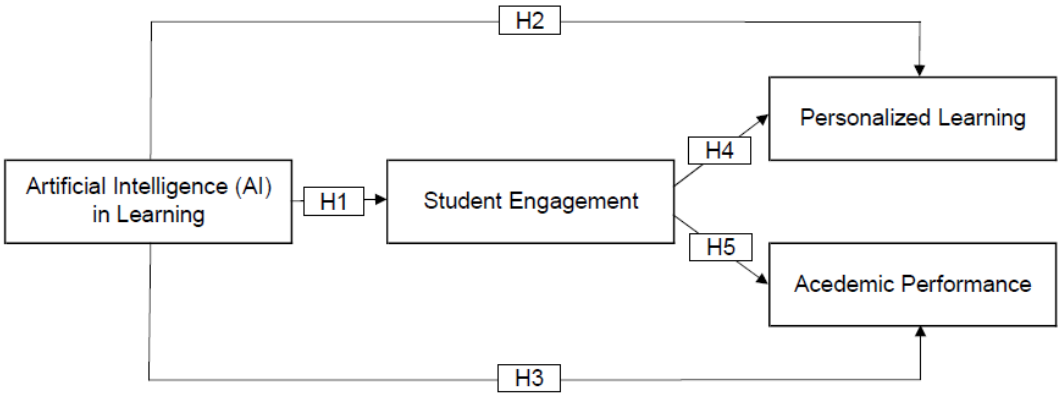

Figure 1. Research Framework

RESEARCH METHOD

This study adopts a quantitative, cross-sectional survey design grounded in a learning-technology integration perspective to examine how AI influences personalized learning and academic performance through student engagement among university students in Malaysia. The theoretical framing is informed by the view that technology-enabled learning tools influence learning outcomes primarily through behavioral and cognitive engagement mechanisms, whereby AI serves as an enabling resource that supports individualized learning processes and enhances academic functioning. Consistent with this logic, student engagement is positioned as a key mediating mechanism linking AI usage to learning outcomes, particularly personalized learning experiences and academic performance.

Sample and Procedures

Data were collected using a structured questionnaire distributed via Google Forms. The survey link was disseminated through social media platforms, including WhatsApp, Telegram, and Facebook, using a non-probability convenience sampling approach. The target population comprised university students in Malaysia who had prior experience using AI tools for learning purposes. A total of 202 usable responses were obtained. All responses were screened and analyzed using SPSS to examine the relationships among the study constructs.

Measures

All constructs were measured using previously validated scales adapted to the AI-enabled learning context. Responses were captured on a five-point Likert scale (1 = strongly disagree, 5 = strongly agree). The full measurement items for all constructs are provided in **Appendix 1**.

Artificial Intelligence (AI) in Learning. AI usage was measured using ten items adapted from Von Garrel and Mayer J. (2023), reflecting the extent to which students use AI tools for academic tasks such as research, writing, and idea development. Example items include “I use AI for research and literature studies” and “I use AI for concept development and design.” The scale demonstrated good reliability (α = 0.881).

Student Engagement. Student engagement was measured using eight items adapted from Xu et al. (2023), capturing students’ behavioral and cognitive involvement in

learning activities (e.g., "During the online class, I paid attention" and "During the online class, I spoke a lot"). The reliability coefficient was α = 0.882.

Personalized Learning. Personalized learning was assessed using eight items adapted from Cheng L. et al. (2023), focusing on the extent to which AI facilitates individualized learning experiences tailored to students' needs and pace (e.g., "AI-based learning tools provide learning materials that suit my individual learning needs" and "AI technology allows me to learn at a pace that matches my personal learning ability"). The scale showed strong reliability (α = 0.870).

Academic Performance. Academic performance was measured using eight items adapted from Pacheco-Mendoza et al. (2023), reflecting perceived academic achievement and learning effectiveness (e.g., "I achieve good grades in my academic courses" and "I can understand the learning materials effectively"). The scale demonstrated good internal consistency (α = 0.880).

RESULTS

Table 1. Summary of Respondents' Demography (N=202)

Response		Frequency	Percentage (%)
Age	18-20	90	44.5
	21-23	83	41.1
	24-26	21	10.4
	Above 26	8	4.0
Gender	Male	95	47.0
	Female	105	52.0
	Prefer not to say	2	1.0
Year of Study	Year 1	54	26.7
	Year 2	81	40.1
	Year 3	51	25.2
	Year 4 or above	16	7.9
Field of Study	Science & Technology	44	21.8
	Business & Management	92	45.5
	Social Sciences	45	22.3
	Arts & Humanities	17	8.4
	Others	4	2.0
Current CGPA	1.00-2.00	1	0.5
	2.01-3.00	30	14.9
	3.01-4.00	171	84.7
Type of Institution	Public University	158	78.2
	Private University	44	21.8
Mode of Study	Full-time	176	87.1
	Part-time	26	12.9
Average Daily Study Time	Less than 1 hour	17	8.4
	1-3 hours	103	51.0
	4-6 hours	65	32.2
	More than 6 hours	17	8.4
Familiarity with AI Tools (e.g., Chatbots, AI tutors)	Not familiar	3	1.5
	Slightly familiar	10	5.0
	Moderately familiar	38	18.8
	Very familiar	151	74.8

Table 1 presents the demographic characteristics of the 202 respondents. The majority of respondents were aged 21-23 years (41.1%), followed by those aged 18-20 years (32.7%), 24-26 years (10.4%), and above 26 years (4.0%). In terms of gender, slightly more than half of the respondents were female (52.0%). For year of study, most respondents were in Year 2 (40.1%), followed by Year 1 (26.7%), Year 3 (25.2%), and Year 4 or above (7.9%). Regarding field of study, the largest group of respondents came from Business and Management (45.5%), followed by Social Sciences (22.3%), Science and Technology (21.8%), Arts and Humanities (8.4%), and other fields (2.0%). In terms of academic performance, the majority of respondents reported a CGPA between 3.01 and 4.00 (84.7%). With respect to institution type, more than three-quarters of respondents were from public universities (78.2%). Most respondents were full-time students (87.1%). In terms of study habits, more than half of the respondents reported studying 1-3 hours per day (51.0%), followed by 4-6 hours (32.2%). Regarding familiarity with AI tools, nearly three-quarters of respondents indicated that they were very familiar with AI tools (74.8%).

Table 2. Summary of Artificial Intelligence (AI) Tools Used in Learning (N=202)

Response		Frequency	Percentage (%)
Types of AI Tools Used (Note: respondents can tick more than one answer)	AI writing assistants (e.g., Grammarly, QuillBot)	119	59.2
	AI chatbots (e.g., ChatGPT, Google Gemini)	117	58.2
	AI image or presentation generators (e.g., Canva)	114	56.7
	AI-powered learning platforms (e.g., Duolingo, Khan Academy)	89	44.3
	AI coding assistants (e.g., GitHub	88	43.8
	AI research tools (e.g., Elicit, Scite)	85	42.3
	AI note-taking tools (e.g., Notion AI)	72	35.8
Frequency of AI Tool Usage	Never	1	0.5
	Rarely	13	6.4
	Sometimes	12	5.9
	Often	97	48.0
	Very Often	79	39.1
Purpose of Using AI Tools (Note: respondents can tick more than one answer)	Studying for exams	129	63.9
	Completing assignments	126	62.4
	Writing essays/reports	116	57.4
	Understanding difficult concepts	112	55.4
	Generating ideas/brainstorming	107	53.0
	Research and literature review	105	52.0
	Coding/programming	96	47.5
	Creating presentations	93	46.0
	Language learning	92	45.5
Most Frequently Used AI Tool	ChatGPT	78	38.6
	Google Gemini	60	29.7
	Canva	19	9.4
	Grammarly	18	8.9
	QuillBot	18	8.9
	Copilot	8	4.0
	Notion AI	1	0.5

Table 2 presents a summary of AI tools used in learning. In terms of AI tools, more than half of the respondents reported using AI writing assistants such as Grammarly and QuillBot (59.2%), AI chatbots such as ChatGPT and Google Gemini (58.2%), and AI image or presentation generators such as Canva (56.7%). Around half of the respondents also used AI-powered learning platforms such as Duolingo and Khan Academy (44.3%), AI coding assistants such as GitHub Copilot (43.8%), AI research tools such as Elicit and Scite (42.3%), and AI note-taking tools such as Notion AI (35.8%). Overall, our findings indicate that students actively engage with a broad range of AI tools, with stronger emphasis on writing, communication, and content generation tools. In terms of usage frequency, almost half of the respondents reported using AI tools often (48.0%), while more than one-third reported very frequent use (39.1%). Only a small proportion reported occasional or infrequent use, including sometimes (5.9%), rarely (6.4%), and never (0.5%), indicating that AI tools have become a regular component of students' learning practices. Regarding the purposes of AI use, more than half of the respondents used AI tools for studying for exams (63.9%), completing assignments (62.4%), writing essays or reports (57.4%), understanding difficult concepts (55.4%), and generating ideas or brainstorming (53.0%). Around half also used AI for research and literature review (52.0%), coding or programming (47.5%), creating presentations (46.0%), and language learning (45.5%). Overall, these findings suggest that AI tools are widely used to support both academic content development and skill-based learning activities. Finally, in terms of most frequently used AI tools, ChatGPT was the most dominant tool, used by more than one-third of respondents (38.6%), followed by Google Gemini (29.7%). Other tools such as Canva (9.4%), Grammarly (8.9%), QuillBot (8.9%), GitHub Copilot (4.0%), and Notion AI (0.5%) were used by smaller proportions of respondents, indicating a strong preference for generative AI chatbots among students.

Table 3. Descriptive Statistics, Cronbach's Alpha Reliability Coefficients, and Zero-order Correlations for All Study Variables

Variables	1	2	3	4
Artificial Intelligence in Learning	**0.71**			
Student Engagement	0.333***	**0.58**		
Personalized Learning	0.502***	0.292***	**0.67**	
Academic Performance	0.462***	0.372***	0.476***	**0.74**
Number of items	10	7	8	8
Mean	4.370	4.026	4.421	4.545
Standard Deviation	0.385	0.452	0.344	0.349

Note: N=202; *p < 0.05, **p < 0.01, ***p < 0.001. The diagonal entries indicate Cronbach's alpha.

Table 3 presents the descriptive statistics, Cronbach's alpha reliability coefficients, and zero-order correlations for the study variables. The results reveal significant positive correlations among all variables, indicating strong interrelationships. Artificial intelligence (AI) in learning is moderately correlated with student engagement ($r = 0.333$, $p < 0.001$), academic performance ($r = 0.462$, $p < 0.001$), and strongly correlated with personalized learning ($r = 0.502$, $p < 0.001$). Besides that, student engagement is weakly correlated with personalized learning ($r = 0.292$, $p < 0.001$) and moderately correlated with academic performance ($r = 0.372$, $p < 0.001$). Furthermore, personalized learning moderately correlated with academic performance ($r = 0.476$, $p < 0.001$). The Cronbach's alpha coefficients ranged from 0.58 to 0.74. Although only two variables achieved the recommended threshold of 0.70, the remaining variables still demonstrated acceptable reliability for exploratory research purposes.

Table 4. Regression Analysis

Variables	Student Engagement	Personalized Learning	Academic Performance
Artificial Intelligence (AI) in Learning	0.333***	0.455***	0.381***
Student Engagement		0.141*	0.245***
R^2 Change	0.111	0.269	0.267
F Value	24.939	36.658	36.260
Durbin-Watson Statistic	1.735	1.816	1.792

Note: N=202; *p < 0.05, **p < 0.01, ***p < 0.001.

The results of the regression analysis are shown below in Table 4. Here we can see the association between AI in learning, student engagement, personalized learning, and academic performance. The findings show that there is a positive and statistically significant influence of AI in learning on all three variables.

Our study reviews that AI in learning positively influences student engagement (β = 0.333***, p< 0.001), providing support for H1. Besides, the results confirm H2 as artificial intelligence in learning positively influences personalized learning (β = 0.455***, p< 0.001). Also, AI in learning positively effects on academic performance (β = 0.381***, p< 0.001), giving support for H3. Additionally, student engagement positively influences personalized learning (β =0 .141*, p< 0.05) and academic performance (β = 0.245***p< 0.001), providing support for H4 and H5. The values of R^2 show that AI in learning is responsible for 11.1% of student engagement variance, and 26.9% of variance in personalized learning and academic performance can be predicted based on the variables included in the model. The F values are significant for all models, thus confirming their reliability. The Durbin-Watson statistics range from 1.735 to 1.816, indicating no serious autocorrelation issue in the regression models. Overall, the results highlight the important role of AI in Learning in enhancing student engagement, personalized learning, and academic performance.

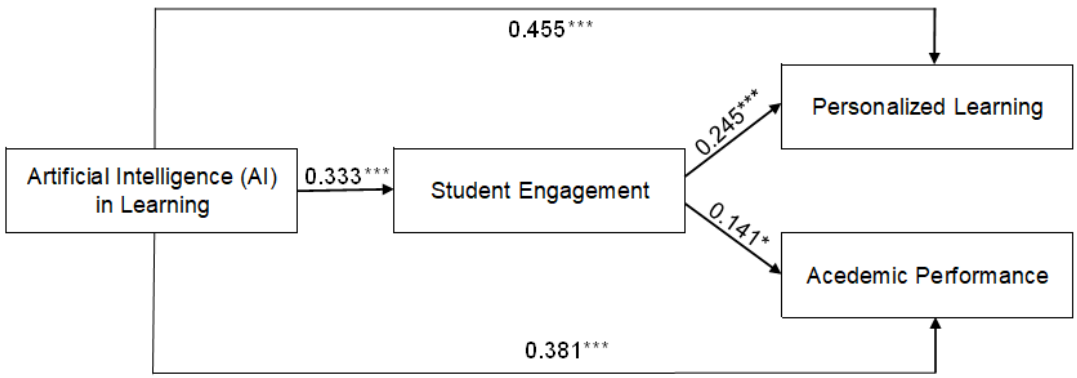

Figure 2. Structural Modal

DISCUSSION

The findings from this research have shed light on the various associations among AI in learning, engagement, personalized learning, and academic performance of students in Malaysian universities. From hypothesis testing, the results show that the postulated connections between AI and learning outcomes in H1, H2, H3, H4, and H5 are valid; engagement is found to be critical in improving not only personalized learning but also academic performance, with AI playing an indirect as well as direct role in learning.

The application of Artificial Intelligence (AI) for learning purposes has also become very significant as a way of increasing student engagement (H1). This is because such AI applications as adaptive learning platforms, bots, and systems for providing feedback are used for creating more interactive and learner-centered learning settings. They allow altering the learning content depending on learners' level of skills and pace of learning. Thus, the material becomes more exciting and comprehensible. As per Kasneci et al. (2023), students can maintain their focus and participate actively in educational processes. Moreover, AI applications also increase learners' motivation to study. Additionally, research indicates that learning environments with AI help promote improved student learning system interaction, leading to higher emotional, behavioral and cognitive engagement (Bond et al., 2021). Furthermore, students' motivation and willingness to participate in online learning activities can be increased by advanced learning technologies which positively influences their levels of engagement (Ullah et al., 2022). AI also promotes collaborative learning through online discussion platforms and communication tools that encourage students to share ideas actively.

Artificial Intelligence has played an important role in increasing personalized learning (H2) by developing learning experiences that match students' individual needs, abilities and learning preferences. With personalized learning, students may study at their own speed and receive materials that are more suitable for their understanding level. According to Chen et al. (2020), AI in education can monitor students' learning and adjust course content to support more effective learning. ChatGPT, Google Gemini, Canva help provide customized learning support and enhance the learning process. Besides, AI tools can provide immediate feedback and personalized guidance to help students understand difficult topics and stay motivated while learning (Zawacki-Richter et al., 2019). Artificial intelligence provides personalized learning in higher education and improves learning effectiveness by enabling adaptive learning systems that tailor content, pace, and feedback to each student's needs (Merino-Campos, 2025). In addition, AI-based learning systems can identify students' strengths and weaknesses which enables focus support and motivates them to become more independent learners. This increases students' satisfaction with their educational experience and provides a more student-centered learning environment. A number of recent studies believe that AI has a good impact on personalized learning by making education more flexible and efficient.

H3 shows that Artificial Intelligence in learning has a positive influence on the academic achievement of students. It means that regular use of various types of artificial intelligence, including ChatGPT and Gemini, contributes to the development of better academic results among learners. Through the use of AI, students enhance their comprehension of study materials by getting instant feedback and explanations. This finding is consistent with Wang, (2025). and Ikram et al. (2026), who found that AI-based learning systems enhance academic performance by identifying learning gaps and offering timely inventions. In addition, AI-supported learning environments allow students to learn at their own pace, which improves comprehension and reduces academic difficulties. Therefore, the result supports the argument that AI is a valuable academic support tool that directly contributes to students' academic success.

As for H4, the results show that student engagement has a significant positive effect on personalised learning. This indicates that students who are more actively engaged in learning activities are more likely to benefit from personalised learning experiences. Engaged students tend to interact more with AI-based systems, participate actively in learning tasks and make better use of adaptive learning tools. As a result, they are more likely to experience learning content that matches their individual needs, preferences and learning pace. According to Karunaratne et al. (2025), there was emphasis on the importance of increased engagement levels because this increases the effectiveness of

personalized learning programs. According to Hu and Kee (2022), students who learn in a flexible and digital environment are required to remain highly engaged to be able to take advantage of adaptive learning techniques. Therefore, student engagement is an important driver in facilitating the effective implementation of personalized learning.

Meanwhile, the findings for H5 reveal that student engagement has positive effect on academic performance as well. This suggests that student who are more engaged in their learning process tend to achieve higher academic results. Students who are engaged more likely to attend class regularly, participate in discussions, complete assignments on time and develop a deeper understanding of academic content. These behavioural, emotional and cognitive engagement dimensions contribute directly to improved academic achievement. This result can be found in Johar et al. (2023), where it stated that student engagement indeed enhances academic performance across different educational settings. In addition, it also emphasised that there is a strong and consistent positive relationship between engagement and academic success, with no evidence suggesting that highly engaged students perform poorly academically. Furthermore, interactive and student-centred learning environments, including AI-supported learning systems, further strengthen this relationship by increasing motivation and learning effectiveness.

Overall, the findings of this study highlight the important role of student engagement as a central mechanism that links AI in learning with both personalised learning and academic performance. While AI provides the technological foundation for adaptive and intelligent learning environments, student engagement determines how effectively these tools are utilised. A greater level of student engagement will make it easier for AI-supported learning technologies to be effective, which will be beneficial for the learning process and the results gained by students.

As far as practice goes, the research conducted makes it clear that when introducing AI technologies, it is vital to not only think about the technologies themselves, but also about creating engaging learning environments for students. In higher education, students need to be encouraged to take an active role in the learning process using AI technologies.

In conclusion, this paper has proved that AI, learning, engagement, personalized learning, and performance are highly related concepts. This research has contributed immensely to the understanding of AI-based learning environments while pointing out the relevance of engagement as a determinant of maximizing performance in higher education, especially in Malaysia.

CONCLUSION

This study provides rich, fine-grained evidence on students' AI adoption in learning by capturing not only the breadth of tools used, but also the frequency, purposes, and preferred platforms in a single integrated framework. Unlike prior research that tends to focus narrowly on either general AI usage or a single tool such as ChatGPT, this study systematically differentiates across multiple categories of AI tools (for example, writing assistants, chatbots, coding assistants, research tools, and learning platforms) and links them to specific academic functions such as exam preparation, assignment completion, conceptual understanding, and research support. This level of specificity offers a better understanding of how students strategically integrate AI into different dimensions of their academic work. In addition, the findings reveal clear usage patterns, including the dominance of generative AI chatbots and the high frequency of routine AI engagement, highlighting the normalization of AI as part of everyday learning practices. These findings

extend existing literature by moving beyond general adoption narratives to provide a more differentiated and practice-oriented account of AI-enabled learning behaviors among university students.

Beyond describing usage patterns, our study demonstrates that AI-enabled learning environments play a significant role in influencing how students learn, engage, and achieve academic outcomes. Rather than functioning as a peripheral tool, AI emerges as an embedded learning resource that supports more adaptive and responsive educational experiences. By enabling personalized feedback, tailored content, and flexible learning pathways, AI enhances the extent to which learning is individualized, thereby improving the relevance and quality of students' educational experiences. Importantly, student engagement is identified as a key explanatory mechanism through which AI influences both personalized learning and academic performance. Our findings indicate a partial mediating role of student engagement, suggesting that AI affects learning outcomes both directly and indirectly through students' cognitive, behavioral, and emotional involvement in the learning process. This highlights a dual pathway through which AI contributes to educational outcomes.

From a theoretical perspective, our study contributes to the literature on educational technology and digital learning by integrating AI into a mediation framework that clarifies how learning outcomes are achieved. It extends current understanding by demonstrating that the effectiveness of AI is not solely based on its technological capabilities, but also on the extent to which it activates and sustains student engagement as a central learning mechanism. From a practical standpoint, our findings suggest that higher education institutions should not only adopt AI tools as part of digital transformation initiatives but also actively design learning environments that maximize student engagement. Ensuring that students remain actively involved in AI-supported learning processes is essential for translating technological innovation into meaningful academic benefits. Overall, our study positions AI as a transformative force in higher education, emphasizing that its value lies not only in enhancing efficiency or personalization, but also in its ability to promote deeper student engagement that partially explains its positive impact on learning and academic performance.

LIMITATIONS

Our study has several limitations. First, our findings are based on self-reported data, which may not fully reflect actual patterns of AI use or distinguish between superficial use (for example, quick answers or editing support) and deeper learning-oriented engagement (for example, critical thinking or iterative problem solving). Second, although a wide range of AI tools and usage purposes were identified, our study does not examine the intensity, context, or combinations of tool use, limiting a deeper understanding of how different AI applications are integrated into learning processes. Third, the cross-sectional design captures usage at a single point in time and does not account for the nature of AI technologies and students' changing adoption behaviors.

DECLARATION OF CONFLICTING INTERESTS

All authors have declared no potential conflicts of interest concerning the study, authorship, and/or publication of this article.

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ABOUT THE AUTHOR(S)

1st Author
Dr. Daisy Mui Hung Kee is an Associate Professor at the School of Management, Universiti Sains Malaysia (USM). She earned her PhD from the University of South Australia and an MBA from USM. She has authored 90 Web of Science-indexed publications. Dr. Kee serves as the Country Director for the Association of International Business and Professional Management (AIBPM) and the STAR Scholars Network. Email: daisy@usm.my ORCID ID: 0000-0002-7748-8230.

2nd Author
Tan Wen Yi is currently an undergraduate student at the School of Management, Universiti Sains Malaysia. Email: wenyi27@student.usm.my.

3rd Author
Syarifah Adlina binti Abdul Rahim is currently an undergraduate student at the School of Management, Universiti Sains Malaysia. Email: syarifah@student.usm.my.

4th Author
Tan Pei Yi is currently an undergraduate student at the School of Management, Universiti Sains Malaysia. Email: peiyi30@student.usm.my.

5th Author
Tan Zhi Wen is currently an undergraduate student at the School of Management, Universiti Sains Malaysia. Email: tanzhiwen005@student.usm.my.