

ACCESSIBILITY, LEARNING MOTIVATION, AND PERSONALISED LEARNING EXPERIENCE OF AI CHATBOTS: ASSOCIATIONS WITH STUDENTS' ACADEMIC PERFORMANCE

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Abstract: *This study examined the relationship between selected dimensions of AI chatbot use and students' academic performance among full-time undergraduate students at a Malaysian higher education institution. Specifically, the study investigated whether academic performance differed by gender and whether accessibility, learning motivation, and personalised learning experience associated with AI chatbots significantly predicted academic performance. A cross-sectional quantitative survey was conducted using a 30-item questionnaire administered through Google Forms. Data collected from 297 respondents were analysed using an independent-samples t-test and multiple linear regression. The independent-samples t-test indicated no statistically significant difference in academic performance between male and female students, $t(295) = 1.605$, $p = .110$. The multiple linear regression model was statistically significant, $F = 41.021$, $p < .001$, explaining 29.6% of the variance in academic performance ($R^2 = .296$). Accessibility was positively associated with academic performance ($B = .105$, $p = .050$), while learning motivation ($B = .249$, $p < .001$) and personalised learning experience ($B = .259$, $p < .001$) demonstrated statistically significant positive associations. Overall, the findings suggest that accessibility, learning motivation, and personalised learning experience are important factors associated with students' academic performance in the context of AI chatbot use. The findings provide insights for students, educators, and higher education institutions seeking to integrate AI chatbots effectively as supplementary learning tools.*

Keywords: *artificial intelligence chatbots, academic performance, accessibility, learning motivation, personalised learning, higher education*

Introduction

Artificial intelligence (AI) has become increasingly embedded in educational environments, with AI chatbots providing conversational access to information, explanations, study resources, feedback, and personalised learning support. Chatbots can simulate human-like interaction and assist learners with academic tasks while reducing some repetitive demands placed on educators (Adiguzel et al., 2023; Shamsuddinova et al., 2024). The rapid adoption of tools such as ChatGPT has therefore generated substantial interest in how AI-supported learning affects students' academic outcomes.

Evidence reviewed in the present study indicates several potential benefits. Chatbots have been associated with improved learning outcomes, student satisfaction, engagement, and academic support (Pérez et al., 2020; Essel et al., 2022). Lee et al. (2022) reported positive effects of an AI-based chatbot on college students' after-class review, academic performance, self-efficacy, learning attitude, and motivation. Similarly, Vanichvasin (2022) found that chatbot-supported entrepreneurship education was associated with improved learning outcomes and student satisfaction. These findings suggest that the educational value of chatbots may depend not simply on their availability but on how they support students during learning.

At the same time, AI chatbot use raises concerns about academic integrity, information accuracy, overdependence, and students' critical engagement with learning materials. Cotton et al. (2023) highlighted the challenge of maintaining academic integrity in the era of ChatGPT, while Liu et al. (2022) noted that excessive reliance on AI assistance may affect deep learning processes. The quality and appropriateness of chatbot responses can also influence the

usefulness of AI-supported learning. Thus, the academic contribution of chatbots should be examined in relation to concrete characteristics of the learning experience rather than assumed to be uniformly positive.

The present study focuses on three dimensions of AI chatbot use: accessibility, learning motivation, and personalised learning experience. Accessibility concerns students' ability to obtain chatbot assistance when and where it is needed. Learning motivation concerns the extent to which chatbot-supported learning encourages interest, engagement, confidence, and commitment. Personalised learning experience concerns the extent to which chatbot support can respond to individual learning needs and preferences. Previous research provides theoretical and empirical support for all three dimensions (Malik et al., 2021; Hanum Siregar et al., 2023; Shahzad et al., 2024; Tian et al., 2024).

A further issue is whether students' academic performance differs according to gender. Previous studies have reported differences in the adoption and use of AI chatbots between male and female students, although the direction and significance of such differences vary across contexts (Elshaer et al., 2024; von Garrel & Mayer, 2023). Accordingly, this study examined gender differences in academic performance while also evaluating the contribution of accessibility, learning motivation, and personalised learning experience to academic performance.

The study addressed two objectives: (1) to determine whether there is a significant mean difference in academic performance between genders; and (2) to determine whether accessibility, learning motivation, and personalised learning experience of AI chatbots contribute significantly to academic performance. The study therefore contributes context-specific evidence from Malaysian higher education and provides practical insight into how AI chatbot use may be integrated into learning while maintaining attention to students' academic development.

Literature Review

AI Chatbots and Academic Performance

AI chatbots can function as virtual teaching assistants, conversational learning partners, and sources of immediate academic support. Pérez et al. (2020) identified educational applications of chatbots as potentially beneficial for learning outcomes, while Essel et al. (2022) found that students using a virtual teaching assistant chatbot demonstrated favourable learning outcomes. Belda-Medina and Calvo-Ferrer (2022) similarly reported positive views toward chatbot use as conversational partners in language learning. These studies indicate that the educational value of chatbots can arise from rapid interaction, availability, and opportunities for repeated practice.

The growing use of generative AI further strengthens the relevance of this issue. Von Garrel and Mayer (2023) reported substantial student use of ChatGPT and other AI-based tools for activities such as clarification, research, translation, text analysis, and writing. Shahzad et al. (2024) also reported that students perceived AI and smart-learning applications as beneficial to academic achievement. However, the benefits of AI-supported learning should be considered alongside risks associated with inappropriate or excessive use, particularly where students rely

on generated answers rather than developing their own understanding (Cotton et al., 2023; Liu et al., 2022).

Accessibility

Accessibility is an important characteristic of chatbot-supported learning because students can seek assistance outside conventional classroom hours and across multiple devices. AI chatbots can be deployed through web and mobile platforms, allowing learners to access educational support at their convenience (García-Martínez et al., 2023; Mateos-Sanchez et al., 2022). Malik et al. (2021) reported positive associations between chatbot adoption, perceived convenience, and enhanced academic performance. Vanichvasin (2022) likewise found positive educational outcomes and satisfaction associated with chatbot-supported learning.

The present study therefore treats accessibility as a practical mechanism through which AI chatbots may support academic performance. When students can obtain immediate responses, locate relevant information, and use chatbots on different devices, the technology may reduce barriers to obtaining academic assistance and facilitate more continuous learning.

Learning Motivation

Learning motivation is closely related to students' willingness to engage with academic tasks and persist when learning becomes difficult. AI chatbots may support motivation by providing immediate feedback, interactive communication, and personalised assistance. Hanum Siregar et al. (2023) found a positive contribution of ChatGPT use to students' learning motivation, while Chaiprasurt et al. (2022) reported improved motivation in a blended-learning environment incorporating a chatbot. Lee et al. (2022) also found positive effects of an AI-based chatbot on students' learning attitude and motivation.

The mechanism is potentially explained by the immediacy and responsiveness of chatbot interaction. Students can ask follow-up questions, request clarification, and receive assistance without waiting for a scheduled class or consultation. Such characteristics may encourage active participation and sustain learning engagement. Nevertheless, the motivational value of AI chatbots depends on students using them as learning support rather than as a substitute for independent thinking.

Personalised Learning Experience

Personalised learning refers to the adaptation of learning content, support, or pace to learners' individual needs and preferences (Shemshack & Spector, 2020). AI chatbots are well suited to this function because they can respond to user prompts and generate explanations, examples, questions, and feedback according to the interaction. Labadze et al. (2023) identified personalised educational experiences as an important potential benefit of AI chatbots, while Tian et al. (2024) reported that AI chatbot adoption in higher education is associated with students' perceptions and learning experiences.

Personalisation may support academic performance by helping students address knowledge gaps, obtain explanations at an appropriate level, and work through material at their own pace. Shahzad et al. (2024) similarly highlighted the role of AI-supported personalised learning in students' perceptions of academic achievement. The present study consequently tests whether

personalised learning experience significantly contributes to academic performance after accounting for accessibility and learning motivation.

Gender and Academic Performance

Gender differences have also been examined in studies of AI chatbot adoption and academic use. Von Garrel and Mayer (2023) reported higher use among male students than female and diverse students in their study context, while Elshaer et al. (2024) examined gender and study discipline as potential moderators of ChatGPT acceptance and use. Such findings demonstrate that gender may be relevant to AI adoption; however, differences in chatbot use do not necessarily imply differences in academic performance. The current study therefore tests academic performance directly using an independent-samples t-test.

Methodology

Research Design and Participants

This study employed a quantitative cross-sectional research design to examine the association between selected AI chatbot-related learning characteristics and students' academic performance. The study involved full-time undergraduate students at a Malaysian higher education institution. A simple random sampling technique was reported, and the minimum sample size was determined using the Raosoft sample size calculator at a 95% confidence level and 5% margin of error, resulting in a target sample of 297 respondents. Data were collected using an online questionnaire distributed through Google Forms and WhatsApp.

Research Instrument

The questionnaire consisted of four multi-item constructs: accessibility, learning motivation, personalised learning experience, and academic performance. Each construct was measured using six items, resulting in 24 construct-related items. All items were measured using an eight-point Likert scale ranging from 1 (strongly disagree) to 8 (strongly agree). The questionnaire items were adapted from previously published studies and contextualised to reflect students' use of AI chatbots for academic purposes. The operational definitions and questionnaire items are presented in Table 1.

Table 1 Items for each construct

Construct	No. of items	Operational definition	Main source(s)	Scale
Accessibility	6	Students' perceived ability to obtain AI chatbot assistance conveniently when and where needed	Malik et al. (2021); Vanichvasin (2022)	1–8
Learning Motivation	6	Extent to which AI chatbot-supported learning encourages interest, engagement, confidence and commitment	Hanum Siregar et al. (2023); Shahzad et al. (2024)	1–8
Personalized Learning Experience	6	Extent to which AI chatbot support responds to individual learning needs and preferences	Tian et al. (2024); Shahzad et al. (2024)	1–8
Academic Performance	6	Students perceived academic performance associated with their learning experience	Malik et al. (2021); Tian et al. (2024)	1–8

A pilot study involving 30 students was conducted before the main data collection to assess the instrument's reliability. Cronbach's alpha coefficients for the actual study were 0.874 for accessibility, 0.875 for learning motivation, .869 for personalized learning experience, and 0.766 for academic performance, indicating acceptable to good internal consistency.

Data Analysis

The data were analysed using IBM SPSS Statistics Version 30. Descriptive statistics were used to summarise respondents' demographic characteristics. An independent-samples t-test was used to examine whether academic performance differed between male and female respondents. Multiple linear regression was then employed to determine whether accessibility, learning motivation, and personalised learning experience significantly contributed to academic performance.

Results

Respondent Profile

A total of 297 students participated in the study. The respondents were predominantly female (76.1%), with most aged 22 years (51.9%) and enrolled in Semester 5 (45.8%). ChatGPT was the most frequently used AI chatbot for academic purposes (55.9%), followed by Perplexity (19.5%) and QuillBot AI (14.8%). Most respondents reported using AI chatbots frequently (45.1%) or very frequently (28.3%), indicating a high level of AI chatbot use among the participating students.

Reliability of the Measures

Table 2 summarises the reliability measure for the actual study conducted. The actual-study Cronbach's alpha coefficients were .874 for accessibility, .875 for learning motivation, .869 for personalised learning experience, and .766 for academic performance. The coefficients indicate that the multi-item measures achieved acceptable internal consistency, with the first three constructs showing good reliability and the academic performance measure exceeding the commonly used minimum acceptable level.

Table 2: Reliability Results

Construct	Items	Cronbach's α
Accessibility	6	0.874
Learning motivation	6	0.875
Personalised learning experience	6	0.869
Academic performance	6	0.766

Pearson Correlation Analysis

A Pearson product-moment correlation analysis was conducted to examine the relationships among accessibility, learning motivation, personalized learning experience, and academic performance. The results indicated that all three variables which are accessibility, learning motivation, and personalized learning experience were positively correlated with academic performance. Additionally, the interrelationships among the predictors were examined prior to conducting a multiple linear regression. As illustrated in the scatter plot matrix (Figure 1), every plot displays a distinct upward linear trend from left to right, visually confirming these positive correlations.

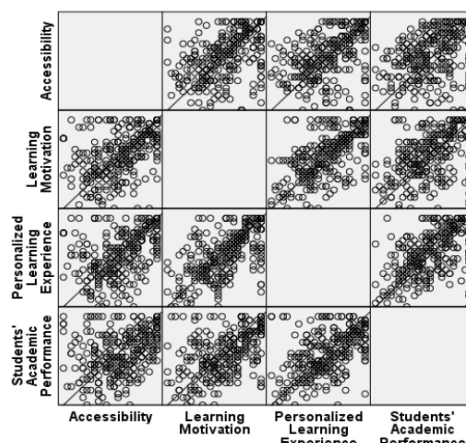


Figure 1 Scatter plot matrix

Gender Difference in Academic Performance

The normality assessment indicated skewness values of -0.047 for male respondents and -0.254 for female respondents, both of which fell within the acceptable range of -1 to $+1$. Levene's test further confirmed the homogeneity of variances, $F = 0.110$, $p = .741$; therefore, the equal-variances-assumed results were used for the independent-samples t -test. The analysis revealed no statistically significant difference in students' academic performance between male and female respondents, $t(295) = 1.605$, $p = .110$, mean difference = 0.2147 , 95% CI $[-0.0486, 0.4780]$. Therefore, the findings indicate that gender was not significantly associated with differences in students' academic performance, and the first research objective was not supported.

Multiple Linear Regression

The regression model examining accessibility, learning motivation, and personalised learning experience was statistically significant, $F = 41.021$, $p < .001$. The model yielded $R = .544$ and $R^2 = .296$, indicating that the three predictors jointly explained 29.6% of the variance in students' academic performance. The remaining 70.4% was attributable to other factors not included in the model. The predictor coefficients, significance levels, and multicollinearity diagnostics are presented in Table 3.

As reported in Table 3, all three predictors were positively associated with academic performance. Accessibility had a positive coefficient of $B = .105$ with $p = .050$; learning motivation had $B = .249$ with $p < .001$; and personalised learning experience had $B = .259$ with $p < .001$. The estimated model was $\hat{Y} = 2.413 + 0.105\text{Accessibility} + 0.249\text{Learning Motivation} + 0.259\text{Personalised Learning Experience}$. Among the three predictors, personalised learning experience had the largest unstandardised coefficient, followed by learning motivation and accessibility.

Multicollinearity was assessed using the tolerance and Variance Inflation Factor (VIF) values. As presented in Table 3, the tolerance values ranged from 0.579 to 0.750, while the VIF values ranged from 1.334 to 1.726. All tolerance values exceeded the recommended threshold of 0.10, and all VIF values were below 10. These results indicate that multicollinearity was not a concern among the predictor variables. Therefore, the multicollinearity assumption for multiple linear regression was satisfied.

Table 3: Multiple Linear Regression Results

Predictor	B	P-value	Decision at $\alpha = .05$	Tolerance	VIF
Accessibility	0.105	0.05	Significant at reported threshold	0.75	1.334
Learning Motivation	0.249	< .001	Significant	0.583	1..715
Personalised Learning Experience	0.259	< .001	Significant	0.579	1.726

Discussion

The findings provide evidence that AI chatbot-related learning characteristics are associated with students' academic performance. The regression model explained 29.6% of the variance in academic performance, indicating a meaningful contribution from accessibility, learning motivation, and personalised learning experience while also demonstrating that substantial variation remains attributable to other factors.

Accessibility and Academic Performance

Accessibility was positively associated with academic performance at the study's reported $\alpha = .05$ criterion ($B = .105$, $p = .050$). This finding is consistent with Malik et al. (2021), who linked perceived convenience and chatbot adoption with enhanced performance, and with Vanichvasin (2022), who reported positive learning outcomes and satisfaction in chatbot-supported entrepreneurship education. Accessible chatbot support may help students obtain explanations and information when conventional academic support is unavailable. However, the relatively small coefficient suggests that accessibility alone is unlikely to determine performance; rather, its value may emerge when access is combined with active engagement and appropriate learning practices.

Learning Motivation and Academic Performance

Learning motivation demonstrated a positive and statistically significant association with academic performance ($B = .249$, $p < .001$). This finding supports Hanum Siregar et al. (2023), who reported a positive contribution of ChatGPT use to learning motivation, and Chaiprasurt et al. (2022), who found increased motivation in chatbot-supported blended learning. It is also consistent with Lee et al. (2022), whose findings linked AI chatbot use with learning attitude and motivation. One plausible explanation is that immediate feedback and interactive assistance reduce delays in the learning process and allow students to maintain engagement with academic tasks.

Personalised Learning Experience and Academic Performance

Personalised learning experience had the largest coefficient among the three predictors ($B = .259$, $p < .001$). This finding supports previous research by Labadze et al. (2023), Tian et al. (2024), and Shahzad et al. (2024), which highlighted the potential of AI-supported personalisation in addressing individual learning needs. Personalised interaction may enable students to obtain explanations, examples, practice questions, and feedback that are better aligned with their perceived learning gaps. Therefore, the educational value of chatbots may be enhanced when they are used as adaptive learning support rather than merely as tools for generating answers.

Gender and Academic Performance

Contrary to the expectation that gender might be associated with different academic outcomes, the present study found no significant difference in academic performance between male and female respondents ($p = .110$). This result is compatible with the observation that differences in chatbot adoption do not necessarily translate into differences in academic performance. Although von Garrel and Mayer (2023) reported higher chatbot use among male students and Elshaer et al. (2024) examined gender as a relevant factor in ChatGPT acceptance and use, the current finding suggests that gender should not be interpreted as a direct determinant of academic performance in this study context.

Implications

The findings have several implications for higher education. First, educational institutions can treat AI chatbots as supplementary learning resources that extend access to academic assistance beyond scheduled classroom interactions. Second, lecturers can encourage students to use chatbots for clarification, practice, feedback, and exploration while reinforcing the need to verify generated information and maintain academic integrity. Third, chatbot-supported learning activities may be designed around motivation and personalisation, since these two dimensions showed comparatively larger regression coefficients than accessibility.

The results also support the need for AI literacy. Students should be taught how to formulate useful prompts, evaluate the accuracy of AI-generated responses, cross-check information against credible sources, and distinguish legitimate learning support from inappropriate substitution of their own academic work. These practices are particularly important given concerns surrounding academic integrity and overdependence on generative AI (Cotton et al., 2023; Liu et al., 2022).

Conclusion

This study examined gender differences in academic performance and the associations between AI chatbot accessibility, learning motivation, personalized learning experience, and academic performance among undergraduate students. The independent-samples t -test revealed no statistically significant difference in academic performance between male and female students. In contrast, the multiple linear regression analysis produced a statistically significant model, explaining 29.6% of the variance in academic performance. Accessibility, learning motivation, and personalized learning experience were positively associated with academic performance, with personalized learning experience demonstrating the largest regression coefficient among the three predictors.

Overall, the findings suggest that the educational value of AI chatbots may be enhanced when students can access these tools conveniently, are motivated to engage with them, and receive learning support that aligns with their individual needs. However, the findings should be interpreted as associations rather than evidence of a causal effect of AI chatbot use on academic performance, given the cross-sectional nature of the study. The effective integration of AI chatbots in higher education therefore requires not only technological accessibility but also the development of students' AI literacy, responsible and ethical use, academic-integrity safeguards, and appropriate guidance from educators. Future research could further investigate these relationships using longitudinal or experimental designs and examine additional factors that may explain students' academic performance in AI-supported learning environments.

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Ethics Statement

Participation in the study was voluntary, and informed consent was obtained from all participants prior to data collection. Participants were informed of the purpose of the study and their right to participate voluntarily. No personally identifiable information was collected, and the confidentiality and anonymity of respondents were maintained throughout the study. The research was conducted with institutional authorisation for academic purposes (Reference No. 500-CK (PJIA/URMI 5/1/1)).

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