Asia Pacific Journal of Management and Education (APJME)
Vol. 9 No. 3, pp.357-370, November, 2026
E-ISSN: 2655-2035 P-ISSN: 2685-8835
https://www.ejournal.aibpm.org/index.php/APJME

From Usage to Outcomes: The Impact of ChatGPT on Academic Performance among University Students in Malaysia and India

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ARTICLE INFORMATION

Publication information

Research article

HOW TO CITE
Oh, Z. J., Muralle, S., Lim, W. W., Li, Y., Liu, P., Liu, Z., Siju, V., Kannan, N., A., R., & Kee, D. M. H. (2026). From usage to outcomes: The impact of ChatGPT on academic performance among university students in Malaysia and India. *Asia Pacific Journal of Management and Education, 9*(3), 357–370.

DOI:
https://doi.org/10.32535/apjme.v9i3.5190

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Received: 16 September 2026
Accepted: 18 October 2026
Published: 20 November 2026

ABSTRACT

This study examines the impact of ChatGPT on the academic performance of university students in Malaysia and India in the context of increasing adoption of artificial intelligence in higher education. The objectives are to analyse the extent of ChatGPT usage for academic purposes, determine its relationship with academic performance and learning effectiveness, and explore students' perceptions of its effectiveness. A quantitative approach was employed using a structured questionnaire distributed to university students in both countries. The collected data were analysed using statistical techniques, including correlation and comparative analysis. The findings indicate that ChatGPT is positively associated with academic performance and learning effectiveness when used as a supportive tool for understanding concepts and completing assignments. However, excessive reliance on ChatGPT may negatively affect students' critical thinking and independent learning abilities. Overall, students in both Malaysia and India perceive ChatGPT as an effective and user-friendly learning tool.

Keywords: ChatGPT; Academic performance; Artificial intelligence in education; University students; Learning effectiveness; Technology adoption

INTRODUCTION

The rapid development of artificial intelligence (AI) is transforming higher education by changing how student access and apply knowledge. One widely used AI tool is ChatGPT, which helps students generate ideas, understand concepts, and complete academic tasks more efficiently (OpenAI, 2023). With the increasing use of digital technologies in countries such as Malaysia and India, AI-based tools are becoming an important part of students' learning practices (UNESCO, 2021).

The use of ChatGPT reflects a shift towards technology-assisted and student-centred learning. It allows students to receive instant explanations, develop ideas, and obtain academic support. As a result, ChatGPT may improve learning effectiveness and academic performance (Dwivedi et al., 2023; Kasneci et al., 2023).

However, over-reliance on ChatGPT may reduce students' critical thinking and independent learning. Students may depend too much on AI-generated answers instead of actively engaging with learning materials (Bender et al., 2021). This raises concerns about whether AI tools are supporting or replacing the learning process.

Although previous studies have explored the use of artificial intelligence in education, limited research has specifically examined the impact of ChatGPT on students' academic outcomes. Most existing studies focus on general AI adoption rather than the influence of ChatGPT on student engagement, learning effectiveness, and academic performance. In addition, there is still limited comparative research involving different national contexts such as Malaysia and India. Differences in educational environments, technology exposure, and learning behaviours may lead to different student experiences and outcomes. Therefore, further research is needed to better understand the educational impact of ChatGPT across these two countries.

Accordingly, this study aims to examine how ChatGPT usage affects academic performance and learning effectiveness among university students in Malaysia and India. It also explores students' usage patterns and perceptions using a quantitative approach.

This study contributes to the existing literature by providing a focused and comparative analysis of ChatGPT in two different national contexts. The findings are expected to offer insights into how AI tools can be used effectively in higher education without reducing essential academic skills.

LITERATURE REVIEW

The proliferation of artificial intelligence (AI) tools in academic settings has emerged as one of the most significant developments in contemporary higher education. ChatGPT, a large language model developed by OpenAI, has attracted particular scholarly attention owing to its rapid and widespread adoption among university students globally. This literature review examines the existing body of research on the impact of ChatGPT usage on student engagement, learning effectiveness, and academic performance, with specific reference to the university contexts of Malaysia and India. The review is structured around the key constructs underpinning this study and concludes with the theoretical justification for the proposed hypotheses.

ChatGPT Adoption and Usage in Higher Education

Since its release in 2022, ChatGPT has been widely adopted by university students. In countries such as Malaysia and India, students use ChatGPT for writing, problem-

solving, and exam preparation (Farrukh et al., 2023; Baidoo-Anu & Ansah, 2023). The Technology Acceptance Model (TAM) explains this adoption. It suggests that students are more likely to use technology when they find it useful and easy to use (Davis, 1989; Tlili et al., 2023). Among these factors, perceived usefulness has a stronger influence on actual usage. This shows why ChatGPT is quickly accepted in higher education.

ChatGPT Usage and Student Engagement

Student engagement refers to how actively students participate in their learning. It includes cognitive, behavioural, and emotional involvement. ChatGPT can increase engagement by providing quick support when students face difficulties (Lo, 2023). For example, students can ask questions and receive immediate answers, which helps reduce frustration and maintain motivation. This is especially important in large university settings where individual support is limited. However, over-reliance on ChatGPT may reduce students' motivation to think deeply. When students depend too much on AI-generated answers, they may become less engaged in the learning process (Tlili et al., 2023). Therefore, the effect of ChatGPT on engagement depends on how students use the tool.

ChatGPT Usage and Learning Effectiveness

Learning effectiveness refers to how well students understand, retain, and apply knowledge. ChatGPT can support learning when students use it to check their understanding, generate ideas, or receive feedback (Kasneci et al., 2023). In this way, it acts as a supportive learning tool that promotes self-directed learning. Studies in Malaysia show that students feel more confident when using ChatGPT, although this does not always mean better understanding (Farrukh et al., 2023). However, ChatGPT may sometimes generate incorrect information, known as "hallucination" (Alkaissi & McFarlane, 2023). If students do not verify the information, their learning may be affected. This suggests that critical use of ChatGPT is important for improving learning effectiveness.

ChatGPT Usage and Academic Performance

Academic performance refers to students' measurable outcomes, such as grades and assignment results. ChatGPT may improve academic performance, especially in writing tasks. It helps students organise ideas, improve language, and complete assignments more effectively (Lim et al., 2023; Ngo, 2023). This is particularly useful for students in multilingual environments such as Malaysia and India. However, the impact is not always positive. If students rely too much on ChatGPT instead of learning independently, their academic performance may not improve (Lo, 2023). Therefore, the effect of ChatGPT depends on whether it is used as a support tool or a replacement for learning.

Student Engagement, Learning Effectiveness, and Academic Performance

Student engagement plays an important role in both learning effectiveness and academic performance. Students who are more engaged are more likely to use ChatGPT in a meaningful and responsible way. This allows them to gain more benefits from the tool (Kasneci et al., 2023). Research also shows that engaged students are better at managing their own learning and achieving higher academic results (Farrukh et al., 2023; Ngo, 2023). In addition, students who are more engaged are less likely to misuse AI tools (Perkins, 2023). Therefore, student engagement is not only an outcome but also a key factor that influences how ChatGPT affects learning effectiveness and academic performance.

Hypotheses Development

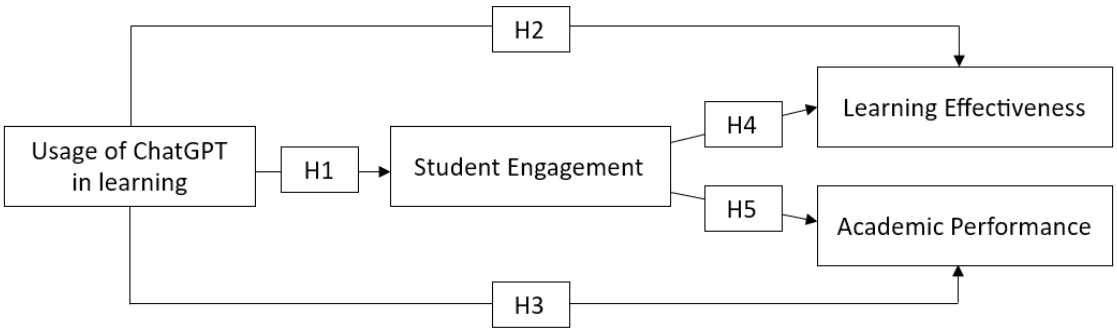
Drawing on the Technology Acceptance Model, self-regulated learning theory, and the empirical literature reviewed above, the present study proposes the following hypotheses:

H1: ChatGPT usage in learning has a significant positive effect on student engagement.
H2: ChatGPT usage in learning has a significant positive effect on learning effectiveness.
H3: ChatGPT usage in learning has a significant positive effect on academic performance.
H4: Student engagement has a significant positive effect on learning effectiveness.
H5: Student engagement has a significant positive effect on academic performance.

Conceptual Framework

The conceptual framework of this study was developed based on the Technology Acceptance Model and previous literature related to AI-assisted learning. The framework proposes that ChatGPT usage influences student engagement, learning effectiveness, and academic performance among university students. The study framework model is depicted in Figure 1.

Figure 1. Research Framework



RESEARCH METHOD

Data for this study were collected through an online survey distributed via Google Forms. Due to accessibility and time limitations, this study employed a convenience sampling method to collect data from university students in Malaysia and India. A total of 169 valid responses were obtained and analysed for this study.

All items in this study, including those related to Usage of ChatGPT in Learning, Student Engagement, Learning Effectiveness, and Academic Performance (see Appendix 1), were measured using a 5-point Likert scale. The scale ranged from 1 (Strongly Disagree) to 5 (Strongly Agree). This format enables respondents to indicate the extent to which they agree or disagree with each statement, allowing the researchers to measure their perceptions, attitudes, and experiences regarding the use of ChatGPT in academic learning. The questionnaire items were self-developed based on the objectives of this study and were pre-tested for clarity, readability, and relevance.

Usage of ChatGPT in Learning: Nine items were designed to assess the extent to which students use ChatGPT as part of their learning activities. These items examined the use of ChatGPT for research, understanding difficult topics, completing assignments, revision, idea generation, clarifying study-related questions, and supporting independent

learning. Example items include: "I use ChatGPT to help me understand difficult topics" and "I rely on ChatGPT as a supplementary learning tool."

Student Engagement: Eight items were developed to measure students' behavioural, emotional, and cognitive involvement in their learning process. These items focused on attention during learning, participation in discussions, effort in completing academic work, focus during study sessions, interest in learning, motivation to explore beyond requirements, enjoyment in learning activities, and deep learning approaches. Example items include: "I participate in discussions" and "I try to understand, not just memorize."

Learning Effectiveness: Eight items were created to evaluate the effectiveness of ChatGPT in supporting student learning outcomes. These items examined whether ChatGPT helps students understand concepts, solve problems, retain information, learn faster, clarify doubts, identify knowledge gaps, and connect theories logically. Example items include: "ChatGPT helps me understand better" and "ChatGPT helps me solve problems."

Academic Performance: Eight items were designed to assess students' perceptions of their academic achievements and overall performance. These items focused on grades, improvement over time, exam performance, assignment quality, satisfaction with academic results, study dedication, participation in academic-related activities, and confidence in academic performance. Example items include: "I achieve good grades in my academic courses" and "I feel confident about my academic performance."

All collected data were analysed using the Statistical Package for Social Sciences (SPSS). Descriptive statistics were used to summarise respondents' demographic profiles and usage patterns. Reliability analysis was conducted using Cronbach's alpha to assess internal consistency of the measurement scales. In addition, correlation and regression analyses were performed to examine the relationships between ChatGPT usage, student engagement, learning effectiveness, and academic performance.

RESULTS

Table Format

Table 1. Summary of Respondent's Demography (N=169)

Response	Frequency	Percent
Age		
Below 18	9	5.3
18 - 20	57	33.5
21 - 23	74	43.5
24 -26	17	10
Above 26	12	7.1
Gender		
Male	88	51.8
Female	81	47.6
Prefer not to say	0	0
Other	0	0
Year of Study		
Year 1	20	11.8
Year 2	67	39.4
Year 3	45	26.5
Year 4 and above	37	21.8

Current CGPA		
0.00 - 1.00	2	1.2
1.01 - 2.00	8	4.7
2.01 - 3.00	43	25.3
3.01 - 4.00	116	68.2
Average Daily Study Time		
Less than 1 hour	50	29.4
1 - 3 hour	59	34.7
4 - 6 hour	50	29.4
More than 6 hour	10	5.9

The table shows the demographic profile of respondents (N = 169). The majority of respondents (N = 74, 43.5%) are aged between 21–23 years, followed by those aged 18–20 years (N = 57, 33.5%). A smaller proportion of respondents are aged 24–26 years (N = 17, 10.0%) and above 26 years (N = 12, 7.1%), while only 9 respondents (5.3%) are below 18 years old.

In terms of gender, most respondents are male (N = 88, 51.8%), while female respondents account for N = 81, 47.6%. No respondents selected “prefer not to say” or “other.”

Regarding the year of study, the largest group of respondents are in Year 2 (N = 67, 39.4%), followed by Year 3 students (N = 45, 26.5%). Respondents in Year 4 and above make up N = 37, 21.8%, while Year 1 students account for the smallest proportion (N = 20, 11.8%).

For current CGPA, the majority of respondents (N = 116, 68.2%) have a CGPA between 3.01 – 4.00, indicating strong academic performance. This is followed by respondents with a CGPA of 2.01 – 3.00 (N = 43, 25.3%). Only a small number reported a CGPA of 1.01 – 2.00 (N = 8, 4.7%) and 0.00 – 1.00 (N = 2, 1.2%).

In terms of average daily study time, the largest proportion of respondents (N = 59, 34.7%) study for 1–3 hours per day. Respondents who study less than 1 hour and 4–6 hours each account for N = 50, 29.4% respectively. Meanwhile, only N = 10, 5.9% reported studying for more than 6 hours daily.

Table 2. Descriptive statistics, Cronbach’s Coefficients Alpha, and Zero-order Correlations for all study variables Note:

Variable	1	2	3	4
1. Usage of ChatGPT in learning	**0.616**			
2. Student Engagement	.466***	**0.521**		
3. Learning Effectiveness	.480***	.316***	**0.415**	
4. Academic Performance	.365***	.447***	.390***	**0.561**
Number of Items	9	8	8	8
Mean	3.5549	3.4712	3.5200	3.4911
Standard Deviation	.51442	.53747	.53021	.58305

N = 169; *p < .05, **p < .01, ***p < .001. The diagonal entries represent Cronbach’s Coefficient Alpha.

Table 2 presents the descriptive statistics, measures of internal consistency, and zero-order correlations among the four study variables. The Cronbach's alpha values ranged from 0.415 to 0.616, indicating moderate internal consistency across the constructs. It is acknowledged that the reliability coefficient for Learning Effectiveness (α = 0.415) falls below the commonly recommended threshold of 0.70. However, as this study employed

newly adapted or self-developed instruments in an exploratory context, lower alpha values are not uncommon. Future research is encouraged to further refine and validate the measurement items to improve reliability.

The mean values of all variables ranged from 3.47 to 3.55 on a five-point scale, suggesting that respondents generally expressed moderate to high agreement with statements related to ChatGPT usage, student engagement, learning effectiveness, and academic performance. Specifically, Usage of ChatGPT in Learning recorded the highest mean (M = 3.5549, SD = 0.51442), followed by Learning Effectiveness (M = 3.5200, SD = 0.53021), Academic Performance (M = 3.4911, SD = 0.58305), and Student Engagement (M = 3.4712, SD = 0.53747).

The correlation analysis revealed that all four study variables were positively and significantly interrelated. Usage of ChatGPT in Learning was positively correlated with Student Engagement ($r = .466$, $p < .001$), Learning Effectiveness ($r = .480$, $p < .001$), and Academic Performance ($r = .365$, $p < .001$). Student Engagement was positively associated with both Learning Effectiveness ($r = .316$, $p < .001$) and Academic Performance ($r = .447$, $p < .001$). Additionally, Learning Effectiveness was positively correlated with Academic Performance ($r = .390$, $p < .001$). Overall, the findings suggest that greater usage of ChatGPT in learning is associated with stronger student engagement, higher learning effectiveness, and improved academic performance among university students.

Table 3. Summary of Regression Analysis

Variable	Learning Effectiveness	Academic Performance
1. Usage of ChatGPT in learning	.378***	.098
2. Student Engagement	.034	.326***
3. Learning Effectiveness	-	.241**
4. Academic Performance	.237**	-
R^2	.285	.275
F value	21.896	20.901
Durbin - Watson Statistic	1.770	1.740

N = 169; *p < .05, **p < .01, ***p < .001.

Table 3 presents the results of the multiple regression analyses examining the predictors of Learning Effectiveness and Academic Performance. The regression model for Learning Effectiveness was statistically significant, $F(3, 165) = 21.896$, $p < .001$, with an R^2 of .285, indicating that the three predictor variables — Usage of ChatGPT in Learning, Student Engagement, and Academic Performance — collectively explained 28.5% of the variance in Learning Effectiveness. The Durbin–Watson statistic of 1.770 suggested no substantial autocorrelation in the residuals.

Within this model, Usage of ChatGPT in Learning emerged as the strongest and most significant predictor of Learning Effectiveness ($\beta = .378$, $p < .001$), suggesting that students who use ChatGPT more frequently in their learning tend to experience higher learning effectiveness. Academic Performance also demonstrated a positive and significant association with Learning Effectiveness ($\beta = .237$, $p < .01$). In contrast, Student Engagement did not exhibit a statistically significant influence on Learning Effectiveness ($\beta = .034$, $p > .05$).

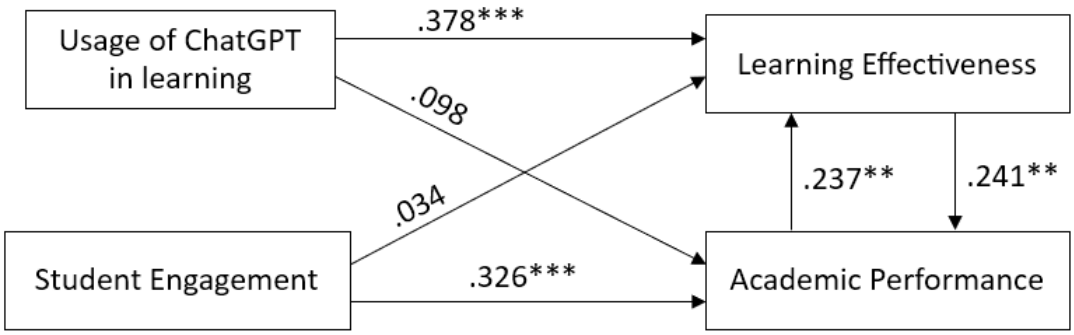
The regression model for Academic Performance was likewise statistically significant, $F(3, 165) = 20.901$, $p < .001$, with an R^2 of .275, indicating that Usage of ChatGPT in Learning, Student Engagement, and Learning Effectiveness together accounted for

27.5% of the variance in Academic Performance. The Durbin–Watson statistic of 1.740 indicated no meaningful autocorrelation in the residuals.

Within this model, Student Engagement was the strongest and most significant predictor of Academic Performance (β = .326, p < .001), indicating that students who are more actively engaged in their studies tend to achieve better academic outcomes. Learning Effectiveness also contributed positively and significantly to Academic Performance (β = .241, p < .01), suggesting that students who learn more effectively are likely to perform better academically. However, Usage of ChatGPT in Learning did not demonstrate a significant direct effect on Academic Performance (β = .098, p > .05), implying that any influence of ChatGPT use on academic performance may be mediated through improved learning effectiveness rather than operating as a direct predictor.

Overall, the regression findings highlight the critical role of Usage of ChatGPT in Learning in enhancing Learning Effectiveness, and underscore the importance of Student Engagement as the primary driver of Academic Performance. These results suggest that while ChatGPT use may not directly boost academic grades, its contribution to deeper and more effective learning may ultimately support students' overall academic achievement.

Figure Format
Figure 2. Overview Result



DISCUSSION

This study aimed to examine the impact of ChatGPT usage on academic performance and learning effectiveness among university students in Malaysia and India. Grounded in the Technology Acceptance Model (TAM) and self-regulated learning theory, five hypotheses were proposed to explore the relationships among ChatGPT usage in learning, student engagement, learning effectiveness, and academic performance. A total of 169 valid responses were collected and analysed using correlation and regression analyses. The findings offer meaningful insights into how AI-assisted learning shapes student outcomes in two digitally evolving national contexts.

This study contributes to the growing body of literature on AI in education by providing a focused, comparative, and quantitative examination of ChatGPT's role in higher learning. Unlike prior studies that examined AI tools in general or focused on a single country, this research specifically interrogates ChatGPT's influence across Malaysia and India — two economies where digital education adoption is accelerating rapidly. The results highlight that the relationship between ChatGPT and academic achievement is not direct but is mediated through engagement and learning processes, a nuance that has important theoretical and practical implications.

The Influence of ChatGPT Usage in Learning on Student Engagement

The first hypothesis (H1) posited that ChatGPT usage in learning would have a significant positive effect on student engagement. The correlation analysis revealed a moderate and statistically significant relationship between these two variables ($r = .466$, $p < .001$). Although the regression analysis did not return a statistically significant beta coefficient for student engagement as a dependent variable of ChatGPT usage ($\beta = .034$, n.s.), the correlational evidence is consistent with prior research suggesting that AI tools can enhance cognitive and behavioural engagement by providing immediate feedback and reducing learning anxiety (Lo, 2023; Tlili et al., 2023).

The non-significance of the regression path from ChatGPT usage to student engagement may reflect the complexity of engagement as a multidimensional construct. Engagement encompasses behavioural, emotional, and cognitive dimensions (Fredricks et al., 2004), and it is plausible that while ChatGPT fosters certain aspects of cognitive engagement such as curiosity and idea generation it may not uniformly activate all dimensions. Furthermore, the passive manner in which some students use ChatGPT, such as simply requesting answers without reflection, may dilute its engagement-promoting potential. These findings suggest that the relationship between ChatGPT and student engagement is contingent upon the quality and intentionality of usage, rather than usage frequency alone.

The Influence of ChatGPT Usage in Learning on Learning Effectiveness

Hypothesis 2 (H2) proposed that ChatGPT usage would have a significant positive effect on learning effectiveness. This hypothesis was supported, with ChatGPT usage emerging as the strongest predictor of learning effectiveness in the regression model ($\beta = .378$, $p < .001$), explaining 28.5% of the variance together with other predictors. The correlation between ChatGPT usage and learning effectiveness was also notably strong ($r = .480$, $p < .001$).

These findings align with the work of Kasneci et al. (2023) and Lim et al. (2023), who demonstrated that AI tools enhance self-directed learning by enabling students to receive tailored explanations, clarify conceptual doubts, and organise their thoughts more effectively. In the contexts of Malaysia and India, where students often navigate multilingual academic environments, ChatGPT offers particular utility in supporting language comprehension and academic writing. The finding reinforces the TAM argument that perceived usefulness — in this case, the ability of ChatGPT to meaningfully support learning — drives actual benefit (Davis, 1989). However, it is important to note that this benefit is most pronounced when students engage with ChatGPT critically, verifying its outputs rather than accepting them uncritically. Alkaissi and McFarlane (2023) cautioned that AI-generated content is susceptible to hallucination errors, and students who fail to evaluate responses may inadvertently reinforce misconceptions.

The Influence of ChatGPT Usage in Learning on Academic Performance

Hypothesis 3 (H3) predicted a significant positive direct effect of ChatGPT usage on academic performance. The results did not support this hypothesis, as the direct path was not statistically significant ($\beta = .098$, n.s.). This finding is among the most theoretically significant outcomes of the study, as it challenges the assumption that increased AI tool usage straightforwardly translates into better academic results.

The non-significant direct effect suggests that ChatGPT operates as an indirect rather than direct driver of academic performance. Its influence is likely channelled through intermediate constructs, namely learning effectiveness and student engagement, which in turn produce measurable academic gains. This pattern is consistent with the process-

oriented view of learning advanced by Biggs and Tang (2011), which holds that academic outcomes are shaped by the quality of the learning process rather than the tools employed per se. Students who use ChatGPT purposefully to deepen understanding and strengthen engagement are better positioned to achieve higher performance, while those who use it superficially for example, to generate assignment content without comprehension are unlikely to derive academic benefit. This underscores the importance of pedagogical guidance in shaping productive AI use behaviours among students.

The Influence of Student Engagement on Learning Effectiveness

Hypothesis 4 (H4) proposed that student engagement would significantly predict learning effectiveness. The correlation was positive and significant ($r = .316$, $p < .001$); however, the regression coefficient was not significant ($\beta = .034$, n.s.) when controlling for other variables. This partial support may be explained by the strong shared variance between ChatGPT usage and student engagement, which may suppress the unique contribution of engagement in explaining learning effectiveness within the regression framework.

Nonetheless, the correlational evidence remains meaningful. Research by Farrukh et al. (2023) and Ngo (2023) consistently demonstrates that students who are actively engaged in their learning — through participation, reflection, and persistence — tend to develop deeper and more durable understanding. In the context of AI-assisted learning, engagement acts as a moderating factor: engaged students are more likely to use ChatGPT as a complementary resource that supplements their own cognitive effort, rather than as a substitute for learning (Perkins, 2023). Future studies employing structural equation modelling may be better positioned to capture these indirect pathways with greater precision.

The Influence of Student Engagement on Academic Performance

Hypothesis 5 (H5) posited that student engagement would have a significant positive effect on academic performance. This was the most strongly supported hypothesis in the regression model ($\beta = .326$, $p < .001$), reaffirming the centrality of engagement in the academic success equation. Students who demonstrate higher levels of behavioural, emotional, and cognitive involvement in their studies are more likely to achieve stronger academic outcomes, regardless of the tools they employ.

This finding is consistent with a substantial body of educational research (Fredricks et al., 2004; Kahu, 2013) and extends it to the AI-assisted learning context. The implication is clear: ChatGPT and similar tools are most valuable when they serve to amplify, rather than replace, student engagement. Educators should therefore focus not only on whether students use AI tools, but on cultivating the habits of mind curiosity, critical evaluation, and self-regulation that allow students to harness AI responsibly and productively.

Managerial and Practical Implications

The findings carry important implications for university administrators, academic staff, and policymakers in Malaysia, India, and comparable educational contexts. First, institutions should develop structured AI literacy programmes that teach students not only how to use tools like ChatGPT, but how to use them critically. This includes understanding the limitations of AI-generated content, developing habits of source verification, and practising reflective engagement with AI outputs.

Second, curriculum designers should explore how ChatGPT can be embedded into formative learning activities rather than summative assessments, preserving academic integrity while maximising the learning benefits of AI. For instance, students could be encouraged to use ChatGPT to explore initial ideas and then critically evaluate and extend those ideas through independent reading and analysis.

Third, policymakers in both Malaysia and India should consider developing national guidelines on ethical AI use in tertiary education, providing a regulatory framework that promotes innovation while safeguarding the intellectual development of students.

CONCLUSION

The current study explored the effects of ChatGPT use on the academic achievement of students in Malaysian and Indian universities, where student engagement and learning effectiveness were considered mediating variables. Adopting a quantitative methodology with 169 participants, the researchers discovered that the use of ChatGPT has a significant relationship with learning effectiveness ($\beta = .378$, $p < .001$), while student engagement serves as the primary predictor of academic achievement ($\beta = .326$, $p < .001$). Notably, ChatGPT does not have a direct effect on academic achievement but an indirect effect through learning effectiveness.

These research findings affirm the notion that AI applications in academia are facilitators rather than academic enhancers. Students who see ChatGPT as a tool to develop their cognitive processes and reasoning skills will more likely succeed academically when using ChatGPT than those who rely solely on it to provide answers to academic questions. Therefore, educational institutions should invest heavily in building competent students who know how to work effectively with the available AI technology.

One contribution of this research study is the multi-country comparison of ChatGPT in higher education, a subject area that has not been adequately addressed in previous literature on the topic. The findings could not be more relevant given the fast uptake of generative AI in educational contexts and the need for scientifically guided recommendations on best practice for integrating this emerging technology within teaching and learning processes.

In conclusion, this study successfully examined the impact of ChatGPT usage on student engagement, learning effectiveness, and academic performance among university students in Malaysia and India. The findings revealed that ChatGPT usage positively influenced learning effectiveness, while student engagement emerged as an important factor influencing academic performance. The study also highlights that ChatGPT functions more effectively as a supportive learning tool rather than a replacement for independent learning. This research contributes to the growing literature on artificial intelligence in education by providing comparative insights from two different national contexts. The findings may help educators and higher education institutions develop more effective and responsible approaches toward AI-assisted learning in the future.

LIMITATION

This study has several limitations. First, the study employed convenience sampling, which may limit the generalizability of the findings to the broader population of university students in Malaysia and India. Second, the data were collected through self-report questionnaires, which may introduce response bias and affect the accuracy of the findings. Third, several constructs demonstrated relatively low reliability values, suggesting that further refinement of the measurement items is needed in future studies. In addition, the cross-sectional design limits the ability to establish causal relationships among the variables. Future studies are encouraged to use larger and more diverse samples, improved measurement instruments, and longitudinal research designs to strengthen the validity and generalizability of the findings.

ACKNOWLEDGMENT

The authors express sincere gratitude to all university students in Malaysia and India who voluntarily participated in this study and generously contributed their time, perspectives, and honest responses. Their willingness to engage with the survey instrument was indispensable to the successful completion of this research, and the authors deeply appreciate the trust they placed in the research team by sharing their academic experiences and perceptions of ChatGPT.

The authors also wish to extend their heartfelt appreciation to the members of the research team for their collaborative spirit, sustained commitment, and dedication throughout every phase of this project from the initial conceptualisation and instrument development to the rigorous data collection, statistical analysis, and manuscript preparation. The team's diverse academic backgrounds and shared enthusiasm for understanding the role of artificial intelligence in education were a constant source of intellectual energy and motivation.

Special recognition is also extended to Universiti Sains Malaysia for providing an intellectually stimulating academic environment that nurtures interdisciplinary research and encourages the exploration of emerging technologies in education. The institutional support and resources made available to the research team have been instrumental in enabling the conduct of this study. The authors further acknowledge the valuable guidance and constructive feedback offered during the peer review and editorial process, which significantly enhanced the quality and rigour of the final manuscript. This work is a testament to the collective effort of all individuals involved, and the authors are profoundly grateful for every contribution, however large or small.

DECLARATION OF CONFLICTING INTERESTS

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

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