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GENERATIVE AI TOOL USAGE AND ACADEMIC PERFORMANCE: THE MEDIATING ROLE OF STUDENT MOTIVATION IN HIGHER EDUCATION

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Abstract
The swift development of Generative Artificial Intelligence (AI) tools has reshaped how students learn in higher education institutions, empowering them with advanced cognitive assistance for learning activities. This study investigates the relationship between academic performance and the use of Generative AI tools, mediated by academic motivation among students at the university level. The study used a quantitative cross-sectional research design with 384 students being sampled, and a structured questionnaire was used for data collection. Data were analyzed with Hayes' PROCESS Macro (Model 4) to test direct and indirect relationships between variables. The results showed a positive relationship between the use of Generative AI tools and academic achievement and motivation. Moreover, the study showed that students' motivation had a significant impact on their academic performance. The results of the mediation analysis showed that student motivation partially mediated the relationship between Generative AI tool usage and academic performance, indicating that the tools have a direct effect as well as having an indirect pathway via student motivation. The study concludes that Generative AI tools act as cognitive and motivational enhancers in higher education environments. The effectiveness was maximized if they are used to support not to replace independent learning, but to strengthen the intrinsic motivation of students. The results add to an increasing body of research examining the role of AI in education and provide actionable insights for teachers and leaders on how to implement AI tools effectively within educational settings.
Keywords: *Generative AI, Academic Performance, Student Motivation, PROCESS Macro, Mediation Analysis.*

Introduction

The use of artificial intelligence (AI) has revolutionized the landscape of higher education, affecting its methods, practices, and expectations in so many significant ways. Specially, AI on text generation, like ChatGPT, Gemini, and Copilot, are seen as promising technologies for education, generating human-like text and aiding students in creating knowledge and completing learning tasks (Kasneci et al., 2023). The use of these tools has also started to gain traction in the educational sector, particularly within higher learning institutions, transitioning to an AI-enabled

learning space where the students learn not just by the teachers and lecturers, but by using intelligent education and learning systems. Though many tools powered by Generative AI are being widely adopted, their potential application in the academic setting is still a relatively new field of research, and some of these tools have raised concerns. AI tools can also help students improve their comprehension and academic writing, as they offer instant feedback and individualized support to help them make these improvements (Iqbal et al., 2023; Kasneci et al., 2023; Zawacki-Richter et al., 2019). But there are also some concerns about academic dependency, as well as less critical thinking and even the use of content created by AI, which can have negative implications for deep learning results. This two-sided lens underscores a particular gap in understanding the impact of Generative AI adoption on academic performance in higher education settings, making it essential for empirical research to fill this gap.

Student motivation has already been established as one of the most important factors that influence learning success, besides academic performance. Motivation can be understood as the internal and external factors that enable, direct, and maintain learning attitudes and acts (Ryan & Deci, 2000), and is a very important factor in determining students' learning engagement and achievement. In a technology enhanced learning environment, a learner's concept of usefulness, ease of use, and educational value of digital affordances can affect motivation. Educational technology research over the last few years suggests that digital learning tools have a positive impact on student motivation and engagement, which ultimately leads to positive academic gains (Bond et al., 2020). While there is a wealth of existing research on concepts including e-learning systems, gamification, and learning management systems, there is less empirical work on the use of Generative AI technology in higher education settings. Furthermore, little is known about the mediating effects of student motivation in the relationship between Generative AI tool use and academic performance. Much theoretical and empirical work is missing from the existing literature in this field (Imran, Akhtar, & Khan, 2026; Haider, et al., 2025).

Self-Determination Theory (SDT) posits that autonomy, competence, and relatedness are fundamental psychological needs that shape motivation, and it is is suggested that Generative AI tools can support students in adopting an adaptive perspective by fostering both autonomy and competence (Ryan & Deci, 2000). Such motivation boosts can then be expected to translate into better academic outcomes, resulting in a more mediated role of Generative AI on academic outcomes. The objective of the present study is to investigate the impact of using the Generative AI tools on students' academic outcomes, and the possible mediation effect of student motivation in this case within the university higher education student sample (Zaidi & Sultana, 2023; Imran, 2022). This research aims to create and validate a mediation model and align the study with the expanding body of research on intelligent education in order to carry out some contribution to it, and give empirical evidence to the psychological mechanism that lies behind AI-assisted learning. The results of this study should have theoretical and practical implications (Imran, Khan, & Rani, 2025; Imran, Sultana, & Jat, 2023). Theoretically it is an extension of SDT in relation to Generative AI implementation in the educational context. In real-world terms, it offers guidance and understanding of how AI can be used effectively to support student motivation and performance in today's evolving digital learning landscape, for educators, policymakers, and higher education institutions.

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Research Objectives

- To examine the effect of Generative AI tool usage on academic performance.
- To assess the effect of Generative AI tool usage on student motivation.
- To determine the effect of student motivation on academic performance.
- To investigate the mediating role of student motivation in the relationship between Generative AI tool usage and academic performance.

Research Questions

- What is the effect of Generative AI tool usage on academic performance?
- What is the effect of Generative AI tool usage on student motivation?
- What is the effect of student motivation on academic performance?
- Does student motivation mediate the relationship between Generative AI tool usage and academic performance?

Literature Review

Generative AI Tool Usage in Higher Education

The adoption of artificial intelligence (AI) within higher education has gained considerable momentum in the age of the digital transformation that occurred during the pandemic and is reshaping learning, student behaviors and teaching styles.In the post Covid-19 digital transformation, AI has quickly taken root in higher education and has profound impact on teaching methods, learning assessment and student learning (Khoso, et al., 2024; Sultana & Imran, 2024; Ahmad, Bibi & Imran, 2023). Recent developments like ChatGPT, Gemini, and Copilot – all part of Generative AI systems – are ushering in a paradigm shift in learning, going beyond being mere knowledge retrieval tools to becoming content generation cognitive assistants (Kasneci et al., 2023; Tlili et al., 2024). These tools are steadily being integrated into academic settings to allow students to create essays, solve problems, and even receive real-time academic assistance (Imran, Akhtar, & Khan, 2026; Zaidi, et al., 2024). Recent studies give emphasis that Generative AI solutions can contribute to increasing academic productivity, by mitigating cognitive overload and making academic tasks more efficient, especially in academic fields, where writing is an integral part of academic work (Dwivedi et al., 2023). Similarly, it is suggested that AI–like tools could serve as scaffolding structures to facilitate learner-generated knowledge (Baidoo-Anu and Ansah, 2023). AI implementation in the education sector is also transforming the pedagogical approach towards dynamic learning landscapes or adaptive learning ecosystems that cater to individual learning needs, as pointed out by Crompton and Burke (2023). But there are also concerns identified in the literature regarding the over reliance and academic integrity issues. Research done in 2022-2024 has shown that relying too heavily on AI-generated responses can have a detrimental impact on students' analytical and critical thinking skills (Perkins & Roe, 2023; Cotton et al., 2023). Moreover, issues involving plagiarism, authenticity of academic writing, and diminished intellectual effort have become the bread and butter of recent educational debates (Zhai, 2023). Generative AI use effectiveness is also identified as highly dependent on the learners' digital literacy, metacognitive awareness and SRL skills. Rather, those with high self-regulation have learned to use AI tools strategically to improve their ideas and clarify concepts, whereas those with low self-regulation have been seen to use AI output provisions as definitive answers (Lim et al., 2022; Chen et al., 2023). The range of responses indicates that the adoption of Generative AI

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should be viewed as a multidimensional behaviour pattern and not as one homogeneous 'technology exposure'. The research and empirical evidence on the effects of Generative AI on academic achievement is inconsistent. The findings on learning outcomes vary: positive effects have been reported for accessibility and assistance (Lo et al., 2023); and neutral effects or even negative effects on academic outcomes from cognitive offloading effects have been suggested (Peng Li & Sam Wasfi, 2023; Wang et al., 2024; Zhang & Aslan, 2023). This is inconsistent and will suggest a need to investigate the psychological mediators that can explain this relationship better.

Student Motivation in Educational Contexts

Motivation has been one of the most widely researched areas of educational psychology because of its impact on learning outcomes and academic actions of the students. In general, motivation can be described as a set of internal and external processes that start, guide, and regulate goal-directed behaviors (Ryan & Deci, 2020; Schunk & DiBenedetto, 2021). Self-Determination Theory (SDT) is a strong theory for understanding motivation as it focuses on autonomy, competence, and relatedness as fundamental psychological needs (Deci & Ryan, 2017). When students' needs are met, they show greater intrinsic motivation, in task persistence and engagement. On the other hand, when students' needs are unmet, they tend to be more disengaged and perform poorly academically (Vansteenkiste et al., 2021; Reeve, 2022). Motivation regulation studies have recently validated the influence on students' academic achievements in both classroom and virtual settings. The student motivation has been impacted greatly by the digital transformation in the education field. Increased autonomy and ease of accessing learning materials, resulting from the use of interactive technologies and DLP, has been shown to boost student engagement in learning (Bond et al., 2021; Howard et al., 2022). Likewise, Sailer and Homner (2021) determined that using gamification and interaction in learning promotes intrinsic motivation by making the learner active and allows for feedback. The situation is, however, different in an environment with AI support. Some research setting suggests that AI tools boost motivation by making students feel more competent and they also aid in lowering barriers to learning (Baidoo-Anu & Ansah, 2023), whereas over-automation decreases effortful engagement and self-directed motivation (Perkins & Roe, 2023). The twofold effect suggests that motivation in an AI supported environment is context dependent, which needs further empirical testing.

Academic Performance in Higher Education

Academic performance is an important measure of educational success, usually represented as graded or GPA and scores on standardized tests. It is associated with not only cognitive ability, but also psychological, behavior and environmental factors that impact on learning outcomes (York et al., 2021; Richardson et al., 2022). Recent educational research has been revealing the impact of digital learning environments on academic achievement. Research indicates that technology-based learning systems can enhance student learning and success through offering adaptive learning sequences, personalized feedback, and greater access to learning materials (Means et al., 2021; Tamim et al., 2022). But, learning systems' effectiveness relies on engaged learning and self-regulation. AI in learning environments leads to enhanced academic outcomes associated with the implementation of real-time feedback systems, and automated curriculum content creation processes (Holmes et al., 2022, Chen et al., 2021). However, there are issues with shallow learning and less critical thinking in the overuse of AI tools (Zhai et al., 2023; Cotton et al., 2023). This

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means that cognitive and motivational processes mediate academic performance and that this is not technology dependent.

Generative AI Usage and Academic Performance

Recent years have seen rising demand for scholarly studies on the connection between the use of Generative AI and academic achievement. Initial findings indicate that the use of Generative AI technologies can positively contribute to academic achievement, including factors such as the improvement of writing abilities, conceptual clarity, and efficiency in problem-solving (Kasneci et al., 2023; Dwivedi et al., 2023). These tools are cognitively augmenting systems that help students to partition an academic task and produce suitable content. But according to the concept of cognitive offloading, dependency on AI technologies can also diminish the depth of one's cognitive training and retention of memory (Risko & Gilbert, 2021; Zhang & Aslan, 2023). This can happen in educational settings where achieving superficial learning and the lack of critical thinking are outcomes (Danish, Akhtar & Imran, 2025; Mankash, et al., 2025; Hafeez, Yaseen & Imran, 2019). There are contradictory results found in recent Empirical studies. Some scholars found AI-supported learning has a notable positive effect on academic outcomes (Lo et al., 2023), while other researchers indicated that it has little effect on academic results without taking motivational and behavioral into account (Wang et al., 2024). This implies that use of Generative AI is not the sole determinant of academic performance outcomes.

H1: *Generative AI tool usage has a significant effect on academic performance.*

Generative AI Usage and Student Motivation

The use of Generative AI tools can profoundly impact students' motivation in the way they learn and feel. Based on Self-Determination Theory, Ryan & Deci (2020) state that self-determination is likely to increase motivation when students enjoy autonomy or competence in learning situations. An autonomy aspect of generative AI tools includes that information is easily accessible and can be used to develop solutions without assistance from the teacher (Kasneci et al., 2023). Moreover, AI systems can boost competence by instant feedback and by making more challenging learning acts easier, hence learners' confidence as well (Bond et al., 2021; Lim et al., 2022). Recent research shows that AI-driven learning environments can enhance engagement and intrinsic motivation in various ways, such as creating a more interactive and responsive learning experience (Howard et al., 2022; Sailer & Homner, 2021). In contrast, however, one interpretation is that overuse of AI tools can lead to passive learning and a decrease in human effort, diminishing engagement and motivation (Perkins & Roe, 2023; Cotton et al., 2023). The overall motivational effects of Generative AI are thus currently not proven, but depend on the context.

H2: *Generative AI tool usage has a significant effect on student motivation.*

Student Motivation and Academic Performance

Students' motivation has universal significance in prediction of their academic performance. Students who are motivated have the ability to engage in deeper learning strategies, to be persistent and to perform better academically (Schunk & DiBenedetto, 2021). A key component to achieving sustained academic success is intrinsic motivation which is evident in Self-Determination Theory (Deci et al., 2021). Motivation has been consistently shown through empirical research to boost academic achievement in all sorts of educational contexts (Hattie, 2021; Zimmerman, 2022). Motivation is even more significant in digital learning environments since students' learning

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activities should be self-regulated (Broadbent & Poon, 2021). Therefore, motivation is one of the psychological factors that affect student academic achievement.

H3: *Student motivation has a significant effect on academic performance.*

Mediating Role of Student Motivation

In recent years, research is growing concerned with the relationship among technology use, student motivation, and academic success. Theoretical perspective indicates that the impact of technology on academic achievement does not occur directly, but rather mediates through psychological factors (Ryan & Deci, 2020; Deci & Ryan, 2021) like motivation. It is suggested that for tools based upon Generative AI (GAI), they will improve student learning outcomes through increased motivation to learn, which results in greater student performance. This mediation mechanism is supported by empirical research carried out in related areas, like e-learning and gamification which show that the relationship between the use of digital learning tools and academic performance is closely mediated by motivation (Sailer & Homner, 2021; Jeno et al., 2022). Empirical research on the use of Generative AI tools is scantly available, however, and the challenge for research stands, leaving gaps to be explored.

H4: *Student motivation significantly mediates the relationship between Generative AI tool usage and academic performance.*

Research Gap Summary

To sum up, generative AI tools have changed the gear of higher education with the gain of efficiency and accessibility of learning. Their direct effect on achievement, however, are less established and inconsistent. In a similar manner, student motivation has been shown to be a key factor in academic achievement but its explanation of the relationship between AI and learning in AI learning settings is not fully recognized. The majority of existing studies have concentrated on the traditional digital learning systems in the last two decades, and this focus has overlooked the role of Generative AI technologies in the post-2021 teaching and learning environment. Hence, this research aims to fill this gap by exploring the mediation between the use of Generative AI and student performance in universities by introducing student motivation as the mediator.

Theoretical Framework

The Self-Determination Theory (SDT), developed by Ryan and Deci (2020) is used as the basis for this study. The Self-Determination Theory (SDT) developed by Ryan and Deci (2020) is the basis from which this study is built. SDT states individuals can be motivated and perform better when they have an adequate level of satisfaction with their needs. Besides educational contexts, SDT has been successfully applied to capture students' learning behavior and engagement to learning activities. In the realm of Generative AI, platforms like ChatGPT, Gemini and Copilot can boost student independence by allowing students to test their knowledge and easily get help for their academic studies. These tools can also expand the competency with immediate feedback and easier breakdown of complex tasks (Kasneci et al., 2023). But the use of A.I. tools could lead to less intrinsic engagement if learners are using them passively rather than engaging with learning processes by themselves (Perkins & Roe, 2023). Theoretically, on the basis of SDT this research suggests that the use of Generative AI tool has an effect on academic achievement through student motivation. In particular, AI can boost student motivation through greater autonomy and competence, and in turn lead to better academics.

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Conceptual Framework

The conceptual framework is presented to show the hypothesized relationships between the study variables in the framework of a mediation model. It shows Generative AI Tool Usage as the independent variable, which directly influences Academic Performance (dependent variable). Meanwhile, use of AI tools also impacts Student Motivation, serving as a mediation variable. This positive relationship between student motivation and academic performance is also seen as part of the indirect effect of the use of AI tools. In general, it is a semi-mediated model because the impact of the Generative AI tools on academic performance is mediated through student motivation.

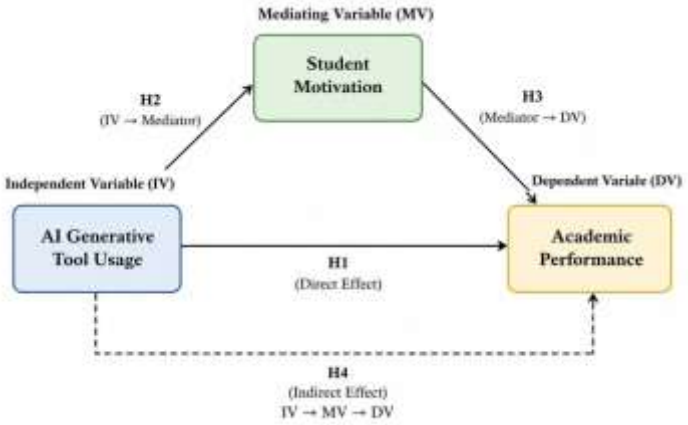

Figure 1

Research Methodology

This study used a quantitative research design and cross-sectional survey approach to investigate the impact of Generative AI implementation on academic achievement with student motivation acting as a mediator for the participants in higher education institutions of Sindh, Pakistan. The quantitative approach was considered appropriate as it enables hypothesis testing and estimation of mediation effects using regression-based techniques. University students studying in higher education institutions in the region of Sindh, Pakistan served as a population for the study. The respondents were selected through a purposive sampling method where participants were asked to be those who already had experience with Generative AI tools like ChatGPT, Gemini or Copilot, for academic tasks. This sampling informed by the criterion resulted in a sample of participants who were genuinely exposed to Generative AI technologies, thus improving the quality of their responses. Because the study centered on a specific sub-group of users, a form of probability sampling was not an option. The sample size was determined through Krejcie and Morgan's (1970) sample size determination table, which recommends a sample size of at least 384 for large populations. Thus, 384 University Students were selected as the samples for the study. This sample size should be regarded as sufficient for regression-based mediation analysis for indirect effect size estimation with PROCESS Macro; essentially, the Macintosh software for conducting mediation analysis by regression.

The data were gathered using a structured questionnaire that was divided into three parts: Generative AI tool usage; Students' motivation; Academic performance. The instrument has been modified from existing scales in the educational and psychological research literature that were

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previously demonstrated to be valid and reliable. Answers were picked on a 5 point Likert scale from strongly disagree (1) to strongly agree (5). Content validity consistency of items had been made by checking with subject experts before the data collection. The emphasis was given on ethical issues throughout the study such as informed consent, voluntary participation, anonymity and confidentiality of respondents. The SPSS software was used for the data analysis. Vital information entered into the data collection form was summarized using descriptive statistics. Hayes' PROCESS Macro (Model 4) was used for inferential analysis of direct and indirect effects between variables. Student motivation was tested as a mediation factor using the bootstrapping method with 5,000 re-sampling and significant results were found by applying biblical confidence intervals. Indirect effect was deemed to be significant if the interval for the parameter did not contain zero.

Results and Analysis

Respondents' Information

Table 1

Demographic Characteristics of Respondents (N = 384)

Variable	Category	Frequency (f)	Percentage (%)
Gender	Male	198	51.6
	Female	186	48.4
Academic Program	Undergraduate	267	69.5
	Postgraduate	117	30.5
University Type	Public University	241	62.8
	Private University	143	37.2
Frequency of Generative AI Tool Usage	Daily	146	38.0
	Weekly	158	41.1
	Occasionally	80	20.9
Commonly Used Generative AI Tool	ChatGPT	214	55.7
	Gemini	88	22.9

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Variable	Category	Frequency (f)	Percentage (%)
	Claude	46	12.0
	DeepSeek	36	9.4

Table 1 shows the demographic profile of respondents for the study. The gender distribution of the 384 participants indicated a spatial parity between genders, with males (f = 198, 51.6%) and females (f = 186, 48.4%). In terms of academic program, there were more undergraduate students (f=267, 69.5%) than post-grade students (f=117, 30.5%). In terms of university type, most participants belonged to public universities (f = 241, 62.8%), while (f = 143, 37.2%) were from private universities. In terms of how often they use generative AI tools, (f = 158, 41.1%) on a weekly basis, (f = 146, 38.0%) daily, and (f = 80, 20.9%) occasionally. When it comes to the commonly-used Generative AI tools, the most widely-used tool among the respondents is ChatGPT, with f = 214 (55.7%). ChatGPT was then followed by Gemini with f = 88 (22.9%), Claude with f = 46 (12.0%), and DeepSeek with f = 36 (9.4%). The results as a whole suggest that students in HEIs have high exposure to the use of Generative AI technologies.

Table 2

Descriptive Statistics of Study Variables

Variable	Items	Mean (M)	Standard Deviation (SD)
Generative AI Tool Usage	6	3.74	0.81
Student Motivation	7	3.68	0.77
Academic Performance	6	3.71	0.79

Descriptive statistics of the study variables (such as Generative AI use, student motivation, and academic performance) are given in Table 2. Based on the results, it was found that the three constructs have values that exceed the median point (3) in the scale 1-5 meaning that there is a relatively positive tendency in the respondents' views. The mean value for respondents' usage of Generative AI tools for academic purposes is 3.74 (SD = 0.81), representing moderate to frequent usage, where the spread of responses is relatively moderate. Students' overall level of motivation is moderately high as shown by the mean score of 3.68 (SD = 0.77). Likewise, academic performance records average value is 3.71 (SD = 0.79), and respondents think that their academic performance is slightly above average. The descriptive outcomes demonstrated a generally balanced distribution with a positive skew for all three variables, where students see the moderate to high usage of AI tools, motivation, and academic performance.

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Table 3
Reliability Analysis of Study Constructs

Constructs	No. of Items	Cronbach's Alpha (α)	Reliability Level
Generative AI Tool Usage	6	0.86	Good
Student Motivation	7	0.88	Good
Academic Performance	6	0.85	Good
Overall Scale	19	0.89	Good

A reliability analysis of the measurement scales used in the study is shown in Table 3. According to the results, the internal consistency of all the constructs is satisfactory. The Cronbach's alpha for using generative AI is 0.86, student motivation is 0.88, and academic performance is 0.85, all greater than 0.70, the standard level of reliability. Moreover, the overall scale reliability is 0.89, indicating good internal consistency of all the items measured within the study. The results obtained in the research show that the instrument applied in this research is reliable and appropriate for further data analysis such as correlation and mediation testing.

Hypothesis Testing

H1: *Generative AI tool usage has a significant effect on academic performance.*

Table 4
Effect of Generative AI Tool Usage on Academic Performance

Predictor	β	SE	t-value	p-value	Decision
Generative AI Tool Usage	0.29	0.06	5.12	< 0.001	Supported
R^2	0.18				

The impact of using Generative AI tools to improve academic performance is shown in Table 4. The results show that the use of Generative AI tools is highly positively associated with academic performance ($\beta = 0.29$; SE = 0.06; $t = 5.12$; $p<0.001$). In addition, the model accounts for 18% of the variance in academic achievement ($R^2 = 0.18$), which is a moderate level of the explanation of the variance. Hence, the hypothesis H1 is accepted, and it is concluded that there is a positive relationship between the increased academic performance of the respondents and the use of Generative AI.

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H2: *Generative AI tool usage has a significant effect on student motivation.*

Table 5

Effect of Generative AI Tool Usage on Student Motivation

Predictor	β	SE	t-value	p-value	Decision
Generative AI Tool Usage	0.41	0.05	7.03	< 0.001	Supported
R^2	0.24				

Table 5 shows the relationships between Generative AI tool use and student motivation. The results show that Generative AI tool usage has a significant positive relationship with students' motivation ($\beta = 0.41$, SE = 0.05, $t = 7.03$, $p < 0.001$). Additionally, the model accounts for 24% of the variance in student motivation ($R^2 = 0.24$), which means it has a moderate predictive power. Based on these findings, H2 is accepted, indicating that there is a positive relationship between the use of Generative AI tools with the levels of student motivation among the respondents.

H3: *Student motivation has a significant effect on academic performance.*

Table 6

Effect of Student Motivation on Academic Performance

Predictor	β	SE	t-value	p-value	Decision
Student Motivation	0.46	0.04	8.21	< 0.001	Supported
R^2	0.27				

The effect of student motivation on academic performance is seen in Table 6. The findings show that student motivation significantly positively influences student academic performance ($\beta = 0.46$, SE = 0.04, $t = 8.21$, $p < 0.001$). In addition, the model accounted for 27% of the variance in academic performance ($R^2 = 0.27$), which is the medium amount of variance. Thus, the H3 is accepted which indicated that the higher the level of students' motivation, the better the students' academic performance in the respondents.

H4: *Student motivation significantly mediates the relationship between Generative AI tool usage and academic performance.*

Table 7

Student Motivation as a Mediator between Generative AI Tool Usage and Academic Performance

Effect Path	Effect (β)	SE	t / BootSE	95% CI	Decision
Direct Effect (AI → Academic Performance)	0.17	0.05	3.40	[0.07, 0.28]	Significant
Indirect Effect (AI → Motivation → Performance)	0.19	0.04	BootSE = 0.04	[0.11, 0.28]	Significant

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Effect Path	Effect (β)	SE	t / BootSE	95% CI	Decision
Total Effect	0.36	0.06	6.00	[0.24, 0.48]	Significant

Note. Bootstrapping was conducted using 5,000 resamples. Mediation is significant when the 95% confidence interval does not include zero.

The mediation model analysis results are shown in table 7, which aims to understand the relationship between the use of Generative AI tools and academic performance through the mediation of student motivation. The overall results of the generative AI tools on academic outcome showed a meaningful relationship between the two variables (β = 0.36, SE = 0.06, t = 6.00, 95% CI [0.24, 0.48]). The direct effect of Generative AI tool use on academic performance is still strong (β = 0.17, SE = 0.05, t = 3.40, 95% CI [0.07, 0.28]), showing that use of Generative AI tools directly affects academic performance even after the control variable is added into the model. In addition, the indirect effect through student motivation is also significant (β = 0.19, BootSE = 0.04, 95% CI [0.11, 0.28]), as the confidence interval does not include zero. This finding is consistent with the results presented earlier, which showed that student motivations exert a significant mediation effect between the use of Generative AI tools and student achievement. Both direct and indirect effects are important, which suggests a partial mediation effect between the use of Generative AI tools and academic achievement, given that the use of Generative AI tools contributes to academic achievement directly, and through an indirect path via Student Motivation. Hence, Hypothesis H4 is accepted.

Discussion

The present study focused on how using Generative AI tools affects academic achievement, and the relationship between this use and academic motivation acted as a meditational factor at the university level in higher education. The results support all hypotheses and indicate a definite pattern of direct and indirect relationships between Generative AI use, student motivation, and academic performance, including partial mediation. The findings of H1 show that the use of Generative AI tools has a positive and significant impact on students' academic outcomes. The results are consistent with the latest research indicating that AI-learning culture bolsters academic productivity by increasing task efficiency and decreasing mental workload on information processing tasks (Dwivedi et al., 2023; Chan & Hu, 2023). Likewise, research in post-pandemic digital classrooms reveals positive academic outcomes from the use of dynamic academic support functions in active generative AI systems: students' results in their tasks have improved and their conceptual clarity has enhanced (Zhai et al., 2023; Sallam, 2023). But the positive impact needs to be viewed with caution because if it is not supported by SRL strategies, learners can become too reliant on the AI and develop rote learning without understanding the concepts (Kasneci et al., 2023).

The results for H2 confirm that the use of generative AI tools has a statistically significant positive effect on student motivation. The finding aligns with current studies showing that AI-powered instructional methods engage students more effectively due to their adaptive nature and diminish learning-related stress (Kohnke et al., 2023; Crompton et al., 2024). Besides, empirical studies in recent years indicate that interactive AI systems can promote students' perception of their

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autonomy in learning, which is well known to be a solid predictor of intrinsic motivational learning in digital learning environments (Lopez & Floridi, 2022; Holmes & Tuomi, 2022). However, others have raised certain concerns that submitting too many riddles with automated tools might decrease intrinsic motivation and lead students to adopt learning behaviors that are more convenient (Perkins et al., 2023; Liu et al., 2024).

In regard of H3, the results show that the effects of student's motivation on academic performance are quite strong and significant. Research on educational psychology in the digital age highlights the importance of motivation as a crucial factor in achieving learning outcomes in SDLE environments (Schunk et al., 2022; Hattie & Clarke, 2021). Motivated learners are more inclined to understand and use deep learning strategies, persist in complex tasks and obtain higher academic achievement in technology-rich contexts (Broadbent et al., 2022; Wong & Jiang, 2023). This further adds to the idea that motivation would be a powerful psychological factor that leads to academic success, especially in an environment where learning takes place through a digital tool.

The mediation results (H4) indicate that using the Generative AI tools affects academic performance in students, while also serving as a partial mediator between the two variables. This indicates that Generative AI tools can impact students academically, both directly and indirectly, through motivation. This dual pathway aligns with the findings of recent research on the effectiveness of AI-driven learning tools conducted via mediation between the psychological factors (engagement and motivation) and the performance of learning tools (Jeno et al., 2022; Lee et al., 2023). The partial mediation suggests that motivation is an important factor but that Generative AI is equally contributing to academic achievement, presumably via cognitive support functions, such as generating ideas and structuring content. Coherently, the results would indicate that the use of Generative AI tools is more than a mere instrument: It is a cognitive-motivational system that has direct impact on cognitive behaviour alongside psychological engagement. Incorporating AI in higher education must therefore be done in a pedagogically balanced way that drives students' motivation without compromising their critical thinking and independent learning.

Conclusion

The current study examined the relationship between the use of Generative AI tools and academic achievements, investigating motivation as a mediating factor, at the university level among students studying in Higher Education. The results indicate that using Generative AI has a direct effect on academic outcomes as well as an indirect effect via the mediating effect of student motivation, as hypothesized in the partial mediation model. The findings show that the use of Generative AI positively impacts academic achievement in numerous ways, such as boosting learning efficiency, completing academic tasks, and fostering conceptual understanding. In parallel, these tools have a positive impact on student motivation by elevating the perceptions of academic task-related autonomy and engagement. It was also noted that student motivation was one of the most important factors that affect academic achievements, and thus plays a pivotal role in influencing the academic achievement of students in technology-enhanced learning environments. The mediation analysis supported that student motivation plays a partial mediating role between the use of generative AI tools for L2 writing and L2 writing achievement. Here, their use of GAr tools as aids does appear to impact their academic performance, but so do fewer tools when they are used to boost students' self-efficacy and motivation. Motivation, therefore, plays a vital role as a psychological mechanism for making AI-based learning tools effective in achieving

successful learnings. The study suggests that in the realm of higher education, Generative AI tools are more than just technological solutions; they are an aid to the learning process. These, however, would only work, if they're linked with learning activities which encourage (de)active participation as opposed to passive dependence. The results also emphasize the need for thoughtful implementation of the use of AI tools in education to promote learning without compromising students' critical thinking and interest.

Recommendations

The following recommendations are made based on the results:

1. The integration of Generative AI tools into the academic domain of Higher Education Institutions should be formalized in teaching and learning processes for improving academic outcomes and supporting student learning processes.
2. Universities must offer structured training programs to build digital literacy and to academically use Generative AI in an ethical and effective way.
3. Teachers should plan meaningful learning experiences that draw on Generative AI tools to enhance students' intrinsic motivation, autonomy, and engagement with schoolwork.
4. All institutional policies should be created to support the responsible use of Generative AI tools to reduce the potential risk of relying too heavily on Generative AI tools and academic misuse.
5. Students should be taught to use Generative AI tools as an assistive aid, not as a replacement to independent thinking and problem-solving tasks.
6. Curriculum developers are encouraged to integrate learning tasks that rely on the use of AI tools to foster higher order thinking skills, critical thinking, creativity, and conceptual understanding.

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