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A STUDY ON THE IMPACT OF AI-BASED LEARNING TOOLS ON STUDENT ENGAGEMENT AND ACADEMIC PERFORMANCE IN HIGHER EDUCATION

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ABSTRACT

Artificial Intelligence (AI) has emerged as a transformative force in higher education by enabling personalized instruction, adaptive learning pathways, and timely feedback. This study examines the impact of AI-based learning tools on student engagement and academic performance in higher education. A quantitative cross-sectional survey was conducted among 150 undergraduate students using a structured questionnaire. Data were analyzed using descriptive statistics, correlation analysis, and regression techniques. The findings indicate that AI-based learning tools have a significant positive influence on student engagement, which in turn significantly affects academic performance. Student engagement was found to partially mediate the relationship between AI-based learning tools and academic performance. The study provides empirical evidence supporting the effective and responsible integration of AI technologies in higher education to enhance learning outcomes.

KEYWORDS: Artificial Intelligence; AI-Based Learning Tools; Student Engagement; Academic Performance; Higher Education.

INTRODUCTION

The rapid advancement of Artificial Intelligence (AI) has significantly influenced teaching and learning practices in higher education. AI-based learning tools, including intelligent tutoring systems, adaptive learning platforms, automated feedback mechanisms, and generative AI applications, provide opportunities for personalized instruction, real-time feedback, and

enhanced learning experiences tailored to individual student needs. These tools not only support knowledge acquisition but also facilitate higher-order cognitive skills, such as critical thinking, problem-solving, and collaborative learning.

Despite their increasing adoption, there is still limited empirical evidence regarding the effectiveness of AI-based learning tools in enhancing student engagement and academic performance, particularly in developing country contexts where access to technology, instructor training, and digital literacy levels may vary widely. Moreover, while AI tools are designed to improve learning outcomes, improper implementation or over-reliance on technology can result in superficial engagement, decreased motivation, or unequal learning opportunities among students.

Therefore, understanding the relationship between AI-based learning tool usage, student engagement, and academic performance is essential for higher education institutions aiming to optimize teaching and learning processes. This study seeks to address these gaps by investigating how AI-based learning tools influence engagement, and in turn, academic outcomes, providing empirical evidence to guide educators, policymakers, and administrators in the effective integration of AI technologies in higher education environments.

MATERIALS AND METHODOLOGY

A quantitative cross-sectional research design was employed to investigate the impact of AI-based learning tools on student engagement and academic performance. Cross-sectional designs are widely used in educational research for assessing relationships between variables at a single point in time [1].

Data were collected from 150 undergraduate students enrolled in higher education institutions. A structured questionnaire was used as the primary data collection instrument, designed based on validated scales from prior research. The questionnaire consisted of three main constructions: AI-based learning tool usage, student engagement, and academic performance. AI-based learning tool usage included items measuring students' frequency of use, perceived usefulness, and satisfaction with AI tools such as intelligent tutoring systems, adaptive platforms, and automated feedback systems [2], [3]. Student engagement was measured using a multidimensional scale encompassing behavioral, cognitive, and emotional engagement [4]. Academic performance was assessed through self-reported grades and students perceived improvement in learning outcomes.

All items were measured on a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree), which is widely used for measuring attitudes and perceptions in educational research [5]. Reliability analysis was conducted using Cronbach's alpha to ensure internal consistency, with values above 0.70 considered acceptable [6], [7]. Data analysis involved multiple steps. Descriptive statistics (mean, standard deviation) were calculated to summarize participants' responses. Pearson correlation analysis was used to examine the strength and direction of the relationships between AI tool usage, student engagement, and academic performance [8]. Finally, regression analysis was conducted to test the hypothesized relationships and assess the mediating effect of student engagement on the relationship between AI-based learning tools and academic performance [9]. All analyses were performed using SPSS version 26, following standard procedures for survey-based research in higher education. This methodology allows a systematic evaluation of the direct and indirect effects of AI-based learning tools on academic outcomes, while ensuring the reliability and validity of the measurements.

RESULTS AND DISCUSSION

The reliability of the measurement instrument was assessed using Cronbach's alpha to ensure internal consistency. The results indicate that the AI-Based Learning Tools construct, measured with 8 items, has a Cronbach's alpha of 0.87, demonstrating good reliability (table 1). Student Engagement, measured with 9 items, yielded a Cronbach's alpha of 0.89, indicating very good internal consistency. Academic Performance, assessed with 5 items, produced a Cronbach's alpha of 0.83, reflecting good reliability. Overall, these values confirm that the questionnaire items are coherent and consistently measure their respective constructs, ensuring that the instrument is reliable for analyzing the relationships among AI-based learning tool usage, student engagement, and academic performance.

TABLE 1: RELIABILITY STATISTICS

VARIABLE	ITEMS	CRONBACH'S ALPHA
AI-Based Learning Tools	8	0.87
Student Engagement	9	0.89
Academic Performance	5	0.83

Descriptive statistics were calculated to summarize the responses of the participants (table 2). The mean scores indicate that students moderately to highly use AI-based learning tools (M = 3.84, SD = 0.62) and are generally engaged in their studies (M = 3.91, SD = 0.58). Academic

performance was also reported at a moderately high level (M = 3.76, SD = 0.64), suggesting that students perceive their learning outcomes positively in the context of AI-supported instruction. These results provide an overview of the general tendencies in AI tool usage, engagement, and academic performance among the sampled students.

TABLE 2: DESCRIPTIVE STATISTICS.

VARIABLE	MEAN	STD. DEVIATION
AI-Based Learning Tools	3.84	0.62
Student Engagement	3.91	0.58
Academic Performance	3.76	0.64

Correlation analysis was conducted to examine the relationships between the study variables (table 3). The findings indicate a significant positive correlation between AI-based learning tools and student engagement ($r = 0.61$, $p < 0.01$), suggesting that higher usage of AI tools is associated with greater engagement. Student engagement was also positively correlated with academic performance ($r = 0.67$, $p < 0.01$), while AI-based learning tools showed a moderate positive correlation with academic performance ($r = 0.49$, $p < 0.01$). These results highlight the interconnectedness of AI tool usage, engagement, and performance, emphasizing the potential of AI technologies to foster better learning outcomes.

TABLE 3: CORRELATION MATRIX.

VARIABLE	AI TOOLS	ENGAGEMENT	PERFORMANCE
AI-Based Learning Tools	1	0.61**	0.49**
Student Engagement	0.61**	1	0.67**
Academic Performance	0.49**	0.67**	1

Regression analysis was conducted to test the hypothesized relationships (table 4). The results reveal that AI-based learning tools significantly predict student engagement ($\beta = 0.61$, $t = 8.42$, $p < 0.001$), confirming that AI tools play an important role in enhancing student involvement in learning activities. Furthermore, student engagement significantly predicts academic performance ($\beta = 0.67$, $t = 9.15$, $p < 0.001$), supporting the mediating role of engagement in translating AI tool usage into improved academic outcomes. Overall, these findings provide empirical evidence that the positive impact of AI-based learning tools on academic performance occurs primarily through increased student engagement, highlighting the importance of promoting active participation in AI-supported learning environments.

TABLE 4: REGRESSION RESULTS

PATH	BETA (β)	T-VALUE	P-VALUE
AI Tools → Engagement	0.61	8.42	0.000
Engagement → Performance	0.67	9.15	0.000

CONCLUSION

The study confirms that AI-based learning tools significantly enhance student engagement, which in turn positively influences academic performance. Student engagement was found to play a partial mediating role in this relationship, indicating that the effectiveness of AI tools on learning outcomes operate largely through fostering active participation, motivation, and cognitive involvement. These findings underscore the importance of not only providing AI-based learning technologies but also designing instructional strategies that encourage meaningful interaction and engagement with these tools.

For higher education institutions, the results suggest that strategic integration of AI tools—such as intelligent tutoring systems, adaptive learning platforms, and automated feedback mechanisms—can lead to substantial improvements in student learning outcomes. Educators should consider training programs to ensure both instructors and students are proficient in leveraging AI tools effectively, while policies should address accessibility and equity to prevent digital divides.

Moreover, the study highlights the need for continuous monitoring and evaluation of AI tool implementation, ensuring that technologies are aligned with pedagogical objectives and promote deep learning rather than superficial engagement. Future research could explore longitudinal effects of AI-based tools, the impact across different disciplines, and the potential role of emerging technologies such as generative AI and learning analytics in enhancing personalized learning experiences.

In conclusion, AI-based learning tools offer promising avenues for improving student engagement and academic performance, but their success depends on intentional design, responsible implementation, and ongoing evaluation. By adopting these practices, higher education institutions can create more interactive, adaptive, and effective learning environments that meet the needs of 21st-century learners.

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