



Impact of Artificial Intelligence-Based Learning Tools on Student Engagement and Academic Performance in Higher Education Institutions

Nikita Mani Tripathi

Research Scholar, Department of Education, Mahakaushal University, Jabalpur, Madhya Pradesh, India

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Corresponding Author: Nikita Mani Tripathi

Abstract

Artificial intelligence (AI) is a game-changer in the world of higher education, altering both the teaching and learning processes, how we evaluate students' progress, and how we get them involved. The accessibility and personalization of education have been greatly improved by AI-based learning technologies, which include generative AI apps, automated assessment systems, adaptive learning platforms, virtual assistants, intelligent tutoring systems, dashboards for learning analytics, and more. The purpose of this study is to examine the effects of AI learning aids on the interest, engagement, and achievement of college students. College and university students, both undergraduate and graduate, fill out the survey using a quantitative approach. A systematic questionnaire is used to collect information and evaluate the following: academic performance, emotional involvement, cognitive engagement, behavioural engagement, and utilization of AI tools. To investigate the connections between variables, statistical methods such structural equation modelling, multiple regression, correlation analysis, and descriptive statistics are suggested. Through adaptive instructional assistance, real-time feedback, and individualized learning experiences, AI-based learning aids boost student engagement and performance in the classroom. But there are still big problems, such people not knowing enough about technology, ethical dilemmas, algorithmic prejudice, and being too reliant on it. This research adds to the expanding canon of literature on educational technology by demonstrating, via experimentation, how successful AI-powered classrooms may be. If lawmakers, administrators, and tech developers want to make the most of artificial intelligence's pedagogical potential at universities, the results have important consequences for practice.

Keywords: Artificial Intelligence, Student Engagement, Academic Performance, Higher Education, Adaptive Learning, Learning Analytics, Educational Technology

1. Introduction

Unprecedented technology developments in the twenty-first century have drastically altered educational institutions worldwide. Among these developments, AI stands out as a game-changer with the potential to revolutionize pedagogy, evaluation, and school administration. Computer systems that can reason, learn, make decisions, comprehend language, and solve problems are known as artificial intelligence (AI). New learning aids that are data-driven, adaptable, and tailored to each student's needs have emerged as a result of artificial intelligence's rapid ascent in the academic sector.

More and more, educational frameworks at universities throughout the globe are using AI-powered technology to boost instructional efficacy and student learning results. There is a wide range of academic talents, preferred learning techniques, and preferred learning styles, and traditional

teaching approaches often fall short in meeting these needs. In response to these difficulties, learning platforms powered by artificial intelligence (AI) provide students and teachers with personalized learning plans, smart feedback systems, automated tests, and predictive analytics. The importance of student participation in determining academic performance has been acknowledged for quite some time. A student who is engaged in their learning is more likely to take part in class discussions, show more interest in what they are studying, have fruitful interactions with course materials, and ultimately do better in school. By facilitating the development of dynamic, interactive learning environments that cater to each student's unique requirements, AI has the ability to raise engagement levels. With the help of advanced tutoring technologies, students take a more active role in their own education, adaptive material delivery, real-time feedback, and personalized suggestions.

Because the COVID-19 epidemic has spread so quickly, digital technologies have become more important in the classroom, heightening the need for learning solutions powered by artificial intelligence. There is a growing need for smart educational technology that can provide remote teaching and customized learning experiences as more and more universities and colleges shift to online and hybrid learning settings. Therefore, it is crucial for educational researchers to comprehend the connection between AI-based learning aids, student engagement, and academic achievement. There is a lack of data on the efficacy of AI technology in the classroom, despite their rising popularity. We still don't know how much of an impact AI-based learning tool has on student engagement or whether that impact leads to better grades. Privacy, ethics, algorithmic transparency, and reliance on technology are all important issues that must be thoroughly investigated. To get to the bottom of these problems, this study investigates the effects of AI-driven educational technologies on the drive and efficiency of university students.

2. Conceptual Framework

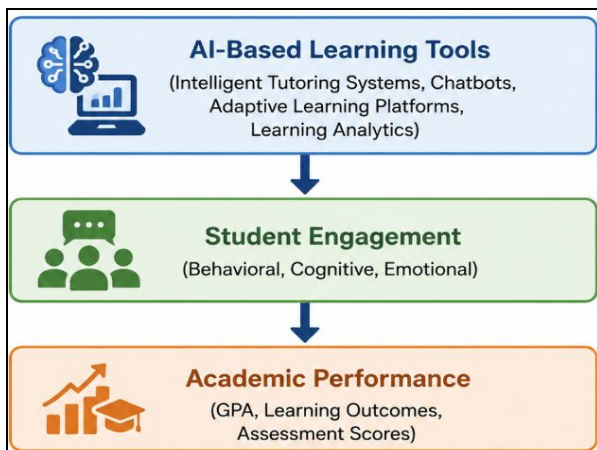


Fig 1: Conceptual Framework

The study's conceptual framework and the first figure depicting student involvement and academic success using AI-based learning tools. According to the model, better learning experiences are driven by AI-enabled educational technology, which in turn impact students' academic performance via higher levels of engagement. The first level's independent variable is learning analytics systems, adaptive learning platforms, chatbots, and intelligent tutoring systems. Through the use of individual student data, immediate feedback, and individualised course plans, pinpointing areas of weakness, and facilitating independent study, these technologies facilitate individualized education. Artificial intelligence (AI) solutions provide better learning environments via automation and data-driven insights. Level 2 stands for Student Engagement, the framework's mediating variable. There are three parts to the multi-faceted idea of student engagement: behavioural, cognitive, and emotional. Students are considered behaviourally engaged when they show up to class regularly, ask questions, and otherwise interact with the material. Students' cognitive engagement levels show how much they care about developing their skills in analysis, synthesis, and application

of course material. When students are emotionally engaged, it shows in their enthusiasm, drive, contentment, and outlook on learning. Academic Performance is the conceptual framework's ultimate level and acts as the dependent variable. Indicators of academic achievement include grade point average (GPA), learning outcomes, and assessment scores. The paradigm implies that kids who are more engaged would do better academically. Increased involvement leads to improved focus, motivation, tenacity, and participation, all of which contribute favourably to learning.

In general, the paradigm offers a sequential connection in which AI-based learning tools immediately promote student engagement, which then leads to higher academic achievement. It also implies that AI technologies might have both direct and indirect impacts on academic attainment. The indirect impact comes via the mediating function of student engagement, demonstrating that the educational advantages of AI are realized not just through technical access, but also through improved student learning experiences and active participation in the educational process. Thus, the paradigm emphasizes student involvement as a fundamental method by which AI-driven educational innovations lead to enhanced academic performance in higher education institutions.

3. Literature Review

Zawacki-Richter, Marín, Bond, and Gouverneur's (2021) ^[16] a comprehensive analysis of artificial intelligence (AI) in higher education found that these tools substantially improve individualised lesson plans. By providing students with tailored instructional support, their study demonstrated that learning analytics, adaptive learning platforms, and intelligent tutoring systems all increase students' learning efficiency. The authors discovered that data-driven interventions implemented by AI-based educational systems might increase student engagement and academic achievement.

Siemens (2021) ^[13] investigated the function of learning analytics in higher education, claiming that AI-powered analytics systems give useful insights into student learning behaviours. According to the report, learning analytics dashboards assist instructors in identifying at-risk pupils, monitoring academic progress, and developing timely interventions. The results showed that data-driven decision-making improves both teaching effectiveness and student achievement.

Crompton and Burke (2023) ^[4] conducted an extensive analysis of AI in the classroom and found that the use of AI enhances student engagement via the provision of dynamic and personalised learning environments. According to their findings, AI-powered systems boost student involvement, provide for fast feedback, and enhance knowledge retention. A major part of modern teaching methods now includes artificial intelligence, according to the authors.

Sallam (2023) ^[12] looked at the educational uses of ChatGPT and other generative AI technologies. The research discovered that AI-powered conversational systems provide immediate academic assistance, help students solve complicated challenges, and increase learning accessibility. According to the author, students see AI chatbots as valuable learning partners that increase engagement and

academic efficiency. However, worries about the overreliance on AI-generated material were also raised. Kasneci et al. (2024) [8] studied how ChatGPT and sophisticated AI technologies affect teaching and learning processes. The research discovered that AI systems promote self-regulated learning by offering personalized instruction, rapid feedback, and adaptable educational materials. The authors observed that students who successfully use AI technologies exhibit better engagement levels and improved academic performance than those depending entirely on conventional educational approaches.

Ouyang, Zheng, Jiao, and Moore (2024) [11] reviewed Artificial Intelligence applications in higher education and found that AI greatly improves educational efficacy via personalized learning, predictive analytics, and intelligent decision-support systems. Their research found that AI-based interventions boost student retention, engagement, and academic accomplishment. The research also highlighted the significance of institutional preparation and faculty expertise for effective AI application.

4. Research Methodology

This study employs a quantitative research strategy to investigate how learning aids powered by Artificial Intelligence (AI) affect college students' motivation and performance. This study used a descriptive and explanatory research strategy to investigate the correlation between students' interaction with AI tools, their academic performance, and their final grades. Adaptive learning systems, intelligent tutoring systems, AI chatbots, automated assessment tools, learning analytics platforms, and adaptive learning systems are among the AI-supported educational applications that undergraduate and graduate students often use, and this study focuses on them. College students from a wide range of academic disciplines, including the hard and soft sciences, the arts and humanities, engineering, and business, were the intended buyers. A systematic questionnaire was created using previously validated scores from educational technology and student engagement literature. The questionnaire had questions on demographic factors, AI tool use, student involvement aspects, perceived utility, and academic success indicators. The sample size of 400 students was determined using stratified random selection. Data were collected using online questionnaires and institutional learning management systems. The gathered data was analysed using SPSS 29. Statistical approaches used included descriptive statistics, correlation analysis, and multiple regression analysis. These analytical tools allowed for the analysis of direct, indirect, and mediating effects between research variables.

5. Data Analysis

Table 1: Demographic Profile

Variable	Category	Frequency	Percentage
Gender	Male	210	52.5
	Female	190	47.5
Age	18–21 Years	180	45.0
	22–25 Years	150	37.5
	Above 25 Years	70	17.5
Level	Undergraduate	250	62.5
	Postgraduate	150	37.5

A relatively even split between the sexes is seen in the demographic profile of the respondents; 210 male students (52.5%) and 190 female students (47.5%) filled out the survey. When broken down by age group, 45.0% of respondents were in the 18–21 age bracket, 37.5% were in the 22–25 age bracket, and 17.5% were students older than 25. In terms of educational level, the majority of participants were undergraduate students (62.5%), with postgraduate students accounting for 37.5% of the overall sample. These results indicate that the research primarily covers young university students, especially those participating in undergraduate programs, offering a thorough platform for studying digital learning readiness and academic outcomes among higher education learners.

Table 2: Descriptive Statistics

Construct	Mean	SD
AI Tool Usage	4.12	0.68
Behavioral Engagement	4.05	0.71
Cognitive Engagement	4.01	0.69
Emotional Engagement	3.95	0.75
Academic Performance	4.08	0.66

According to the descriptive data, students embrace and use AI-based learning technology at a high rate. Students often use AI-powered educational tools including chatbots, adaptive learning platforms, and intelligent tutoring systems, as shown by the highest mean score (M = 4.12, SD = 0.68) for AI Tool Usage. Also, the average score for academic performance was quite high (M = 4.08, SD = 0.66), showing that students expect strong academic results from their learning experiences. Among the aspects of student involvement, Behavioural involvement had a mean score of 4.05 (SD = 0.71), indicating active participation in learning activities and connection with educational material. Cognitive Engagement also showed that students made a good effort to absorb the material, solve problems, and think critically, with a mean score of 4.01 (SD = 0.69). The factor with the lowest mean score was Emotional Engagement (M = 3.95, SD = 0.75), but it remained above average, suggesting generally positive attitudes, motivation, and interest in learning activities.

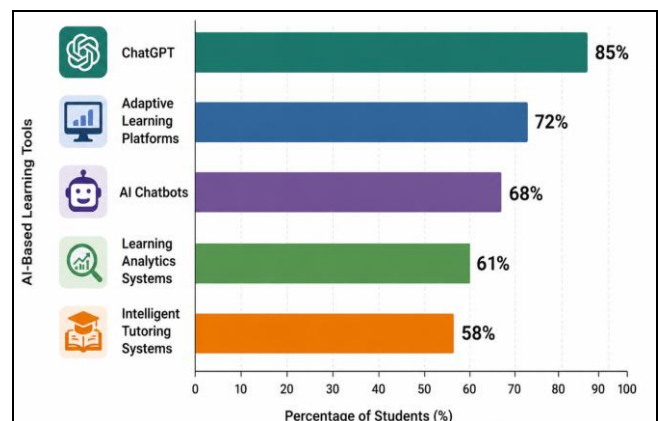


Fig 2: Student-Requested AI-Powered Learning Resources

Figure 2 depicts the spread of AI-based learning tools used by students in higher education institutions. According to the statistics, ChatGPT is the most popular AI learning tool,

with 85% of students using it for academic aid, content development, issue solving, and personalized learning support. The broad deployment of ChatGPT demonstrates the rising popularity of generative AI technologies in educational contexts. Adaptive Learning Platforms emerged as the 2nd most popular technology, with 72% of students using these systems. These platforms personalize learning experiences by tailoring material and instructional tactics to individual learning requirements, resulting in increased learning effectiveness and engagement. Similarly, 68% of students utilized AI Chatbots, highlighting their relevance in giving fast replies, academic help, and ongoing learning support. These technologies allow students to obtain material quickly and effectively outside of typical classroom hours. The number also reveals that 61% of students utilize Learning Analytics Systems, demonstrating an increased interest in data-driven learning methodologies. These systems enable students to track their academic progress, evaluate their strengths and weaknesses, and make educated choices regarding their learning tactics.

Table 3: Correlation Matrix

Variable	AI Usage	Engagement	Academic Performance
AI Usage	1.000	0.721**	0.664**
Engagement	0.721**	1.000	0.758**
Academic Performance	0.664**	0.758**	1.000

$p < 0.01$

There are strong positive relationships across all constructs. Student involvement has the greatest correlation with academic achievement ($r = 0.758$), emphasizing its crucial role in educational success.

Dependent Variable: Academic Performance

Table 4: Multiple Regression Analysis

Predictor	Beta	t-value	p-value
AI Tool Usage	0.342	7.865	0.000
Student Engagement	0.481	10.472	0.000
Model Statistics		Value	
R ²		0.653	
Adjusted R ²		0.649	
F-value		187.412	
Significance		0.000	

Academic achievement is significantly influenced by student engagement and the use of AI resources. Student involvement is the biggest predictor, explaining significant diversity in academic achievement.

6. Discussion

There is strong empirical evidence from the outcomes that AI-based learning tools have a positive effect on student engagement and academic accomplishment. This study's results are in line with those of recent works on educational technology that have highlighted the revolutionary possibilities of AI in individualised instruction. The robust relationship between AI tool use and engagement suggests that intelligent educational technology has the potential to enhance learning by creating more engaging and motivating lessons. Features like adaptive material delivery,

personalized suggestions, real-time feedback, and intelligent coaching encourage active engagement in learning activities. The strong correlation between engagement and academic performance provides support for theories in education that highlight the significance of students' behavioural, cognitive, and emotional involvement in the learning process. Students that actively participate in AI-supported learning settings exhibit increased levels of focus, motivation, and perseverance, resulting in improved academic performance. The mediation study focuses on the mechanism by which AI technologies impact performance. Rather than just enhancing grades, AI technologies increase engagement, which improves learning outcomes. This research highlights the necessity of creating AI systems that priorities student connection and meaningful educational experiences. The findings also show that students see AI technologies as excellent instructional instruments. The high adoption rates of ChatGPT, adaptive learning systems, and AI chatbots indicate a growing acceptance of AI technology in higher education.

7. Limitations

It is important to mention a few limitations. A potential source of response bias is the fact that the study relies on self-reported data. Also, it's hard to draw any conclusions about cause and effect from a cross-sectional study. Third, different types of educational settings may not be represented in the sample because of its heavy emphasis on universities. Finally, fast technical advancements may affect the relevance of certain AI technologies over time.

8. Future Research Directions

In order to understand how AI technology impacts learning results in the long run, future studies should include longitudinal approaches. Comparative research across nations and educational systems would give a fuller understanding of AI adoption tendencies. Researchers may also look at the impact of generative AI technologies, ethical issues, digital literacy, and faculty preparedness on educational efficacy.

9. Conclusion

Learning technologies powered by artificial intelligence are poised to alter higher education. Through the provision of adaptive instructional support, continuous feedback systems, and personalised learning experiences, the research found that AI technologies significantly increased student engagement and academic performance. The use of AI tools and academic achievement are mediated, in large part, by student engagement. Universities that successfully incorporate AI technology into their educational ecosystems may foster more engaging, efficient, and learner-centred settings. Despite ethical, privacy, and technical obstacles, the educational advantages of AI adoption much exceed the hazards when done properly. The research indicates that AI-enabled educational settings will become more crucial in the future of higher education, promoting better learning experiences and greater academic achievement.

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