Artificial Intelligence Integration for Improving Students' Learning Outcomes and Motivation

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ABSTRAK

The integration of Artificial Intelligence (AI) into education has increasingly influenced modern teaching and learning practices. However, the implementation and effectiveness of AI in secondary school settings have not been widely investigated. This research seeks to analyze the influence of AI-supported learning on students' academic achievement and learning motivation. The study applied a mixed-methods approach using a quasi-experimental design involving 60 eleventh-grade students who were separated into experimental and control groups. Data collection was conducted over four weeks through pre-tests, post-tests, and structured questionnaires. Quantitative data were processed using t-test analysis, while qualitative responses were interpreted through thematic analysis. The results reveal that students who participated in AI-assisted learning demonstrated higher academic performance and greater engagement compared to those in conventional learning environments. In addition, the use of AI encouraged more interactive and personalized learning experiences, which positively affected students' motivation. These findings suggest that AI has considerable potential to improve educational quality and support individualized instruction in secondary education. Therefore, this study provides valuable insights into the role of AI as an innovative tool for increasing the effectiveness of teaching and learning processes in schools

Keywor: Artificial Intelligence (AI), Learning Outcomes, Personalized Learning, Student Motivation, Educational Technology

Informasi Artikel

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A. INTRODUCTION

The fast development of Artificial Intelligence (AI) has brought major changes to educational practices by creating more adaptive and personalized learning environments. AI-driven technologies enable teachers to develop instructional methods that address individual student needs, improving the efficiency and effectiveness of the learning process. Recent international studies indicate that AI contributes significantly to increasing student participation and academic achievement through intelligent learning platforms (Bond et al., 2022). In Indonesia, the adoption of digital technology has also been encouraged as part of educational reforms aimed at enhancing learning quality and promoting innovation in teaching practices (Arifin & Muslim, 2023).

Nevertheless, improving students' academic performance continues to be a challenge in many educational contexts. Conventional teaching methods often cannot accommodate differences in students' learning abilities, resulting in passive classroom participation and insufficient conceptual comprehension. Learning motivation is considered an essential factor influencing academic achievement, especially in technology-supported learning environments (Howard et al., 2021). Similar conditions can be found in Indonesia, where low student engagement is frequently associated with the limited implementation of interactive instructional strategies (Sari & Oktaviani, 2022).

Artificial Intelligence provides a potential solution by supporting individualized learning experiences. Using sophisticated algorithms, AI technologies can evaluate student progress and deliver immediate feedback based on learners' specific needs. This method encourages active participation and reflects learner-centered educational principles emphasized in contemporary pedagogy (Luckin et al., 2022). Within Indonesia, digital learning innovations have shown positive impacts on students' involvement and comprehension of learning materials (Prasetyo & Wibowo, 2023).

However, the implementation of AI in education is not without challenges. Limited technological infrastructure, digital literacy gaps, and unequal access to resources can restrict the effectiveness of AI adoption. Additionally, concerns related to ethics, such as data privacy and algorithmic bias, have become important considerations in recent discussions (Selwyn, 2021). In Indonesia, disparities in educational resources across regions continue to hinder the equitable integration of advanced technologies (Rahman & Fitriani, 2022).

Previous studies have explored the application of AI in education, but most have focused on higher education settings. Research indicates that AI-based learning systems can significantly enhance academic performance and learning efficiency (Khosravi et al., 2022). Other studies also emphasize the role of AI in improving student engagement through interactive learning platforms (Chen & Chen, 2021). However, research in secondary education, particularly in developing countries, remains limited (Putra & Santika, 2023).

Moreover, many existing studies focus primarily on technological aspects without thoroughly examining psychological variables such as motivation and engagement. These factors are essential in determining the effectiveness of learning processes. Studies have shown that motivation has a strong influence on academic achievement in digital learning environments (Ryan & Deci, 2020). In Indonesia, student motivation is also

identified as a critical factor influencing learning success (Halim & Anwar, 2022).

Based on these gaps, this study aims to examine the impact of Artificial Intelligence (AI) integration on student learning outcomes and motivation at the secondary education level. This study employs a quasi-experimental design combined with a mixed-methods approach to provide a comprehensive analysis. Such an approach allows for both statistical evaluation and in-depth understanding of students' learning experiences (Creswell & Creswell, 2021).

This study is expected to contribute both theoretically and practically to the field of educational technology. Theoretically, it expands the existing literature on AI integration in education, particularly within developing country contexts. Practically, the findings can support educators and policymakers in designing more effective, technology-driven learning strategies. Furthermore, the integration of AI is expected to promote personalized learning environments that enhance student engagement and overall academic performance.

B. LITERATURE REVIEW

This section reviews previous studies and theoretical perspectives related to the integration of Artificial Intelligence (AI) in education, particularly its influence on student motivation and learning outcomes.

The discussion highlights the role of AI in creating interactive and personalized learning environments, as well as its contribution to improving academic achievement and student engagement. In addition, this review identifies existing research gaps, especially in the context of secondary education in developing countries such as Indonesia.

By examining relevant literature, this study establishes the theoretical foundation and conceptual framework necessary to understand the relationship between AI, student motivation, and learning outcomes.

1. The Role of Artificial Intelligence (AI) in Student Motivation

Student motivation plays a crucial role in determining the success of the learning process. Artificial Intelligence (AI)-based learning environments have been shown to enhance motivation by providing dynamic, interactive, and engaging educational experiences. Research conducted by D'Mello and Graesser (2021) indicates that students utilizing AI-supported platforms demonstrate significantly higher levels of motivation and engagement compared to those in traditional learning environments. Furthermore, Heffernan and Heffernan (2022) emphasize that AI facilitates personalized feedback. This tailored feedback effectively increases students' self-confidence and their willingness to continue learning.

Hypothesis 3 (H3): Based on these studies, it is posited that Artificial Intelligence (AI) positively affects student motivation.

2. Learning Outcomes in AI-Enhanced Education

Learning outcomes are a primary indicator of the success of the educational process, reflecting students' mastery of knowledge and skills. AI-enhanced learning environments provide opportunities for continuous monitoring and assessment, allowing teachers to identify learning gaps more effectively. Studies show that AI-driven systems improve academic performance by offering personalized feedback and adaptive learning strategies (Zawacki-Richter et al., 2022). Additionally, AI helps optimize learning processes by

identifying students' weaknesses and providing targeted interventions (Baker & Inventado, 2021).

In the Indonesian context, improving learning outcomes remains a significant challenge, especially in traditional classroom settings. Research suggests that integrating digital technologies into teaching practices can enhance student achievement and conceptual understanding (Yusuf & Pratama, 2023). Despite these improvements, many educational institutions still rely on conventional methods, which limit the potential benefits of AI integration in improving learning outcomes.

H2: Artificial Intelligence (AI) significantly improves student learning outcomes.

3. Student Motivation in AI-Based Learning Environments

Student motivation plays a crucial role in determining the success of learning processes. AI-based learning environments can enhance motivation by providing interactive and engaging learning experiences. These systems create a dynamic learning environment that encourages students to actively participate in learning activities. Research indicates that students who use AI-supported platforms demonstrate higher levels of motivation and engagement compared to those in traditional learning environments (D'Mello & Graesser, 2021). Furthermore, AI facilitates personalized feedback, which increases students' confidence and willingness to learn (Heffernan & Heffernan, 2022).

In Indonesia, student motivation remains a major issue in education, particularly in teacher-centered classrooms. Studies show that students often experience low engagement due to limited use of interactive and technology-based learning methods (Rahma & Kurniawati, 2022). Therefore, the integration of AI is expected to enhance motivation by providing more engaging and student-centered learning experiences.

H3: Artificial Intelligence (AI) positively affects student motivation

4. Research Gap and Significance of the Study

Although numerous studies have explored the application of AI in education, most of them are conducted in developed countries and higher education contexts. There is still limited research focusing on secondary education, particularly in developing countries such as Indonesia. Previous studies often emphasize technological effectiveness without considering psychological factors such as motivation and engagement simultaneously (Holmes et al., 2023). This creates a gap in understanding the comprehensive impact of AI on learning processes.

Moreover, few studies have employed mixed-methods approaches to analyze both quantitative outcomes and qualitative experiences of students. A comprehensive understanding of AI integration requires examining both academic performance and student perceptions. In Indonesia, research on AI integration at the secondary level is still limited, highlighting the need for further empirical studies (Santoso & Lestari, 2023). Therefore, this study is important to provide a holistic analysis of the impact of AI on student learning outcomes and motivation.

H4: Student motivation mediates the relationship between Artificial Intelligence (AI) and learning outcomes.

C. METHODOLOGY

1. Research Design and Approach

This study employed a mixed-methods approach, integrating both

quantitative and qualitative data to provide a comprehensive understanding of the impact of Artificial Intelligence (AI) on student learning outcomes and motivation. The research design used was a quasi-experimental design with a non-equivalent control group, which allows comparison between experimental and control groups without random assignment. This design is widely used in educational research due to its practicality in real classroom settings (Plano Clark & Ivankova, 2021). The quantitative component focused on measuring changes in learning outcomes, while the qualitative component explored students' perceptions and experiences during AI-assisted learning (Creswell & Guetterman, 2021).

2. Population and Sample

The population of this study consisted of eleventh-grade students at a senior high school in Palu, Central Sulawesi, Indonesia. The research was conducted at one selected school that had access to digital learning facilities and was willing to implement AI-assisted learning. The sample included 60 students divided into two intact classes: one experimental class (30 students) and one control class (30 students). The sampling technique used was purposive sampling, as the selection was based on specific criteria, including students' access to digital devices and teachers' readiness to integrate AI tools in the learning process (Etikan & Bala, 2022).

The selection of eleventh-grade students was based on the consideration that they possess sufficient cognitive maturity and are familiar with digital learning environments, making them suitable participants for AI-based learning interventions. Additionally, selecting intact classes ensures the feasibility of implementing the intervention without disrupting the existing school system (Cohen et al., 2021).

For the qualitative component, the participants were selected from the experimental group to ensure that the data reflected direct experiences with AI-assisted learning. The qualitative data were obtained from 8 students selected from the experimental group using purposive sampling. The selection was based on students' level of participation, ability, and engagement during the AI-assisted learning process. This approach aims to provide in-depth insights into students' experiences and perceptions of AI integration in learning.

3. *Data Collection Techniques and Instruments*

Data were collected using multiple techniques to ensure data triangulation and validity. The primary instruments included pre-test and post-test assessments to measure student learning outcomes. The test items were developed based on the curriculum and validated through expert judgment to ensure content validity. A structured questionnaire was also administered to measure students' motivation and perceptions toward AI-assisted learning. The questionnaire items were adapted from established instruments in educational research, particularly those related to motivation and technology acceptance (Teo et al., 2021).

In addition, semi-structured interviews were conducted with the selected students from the experimental group to gain deeper insights into their learning experiences. Observations were also carried out during the learning process to capture students' engagement and interaction in the classroom. The reliability of the quantitative instruments was tested using Cronbach's alpha, with a threshold value of 0.70

indicating acceptable reliability (Taber, 2021).

4. Research Procedure

The research was conducted in several stages to ensure systematic implementation. The first stage involved preparation, including instrument development, validation, and coordination with the school. The second stage was the implementation phase, which lasted for four weeks. During this phase, the experimental group received AI-assisted learning using tools such as AI-based tutoring systems and digital platforms, while the control group was taught using conventional teaching methods.

The third stage involved administering the post-test and distributing questionnaires to both groups. Interviews were conducted with the selected participants from the experimental group after the completion of the learning intervention to capture their experiences and perceptions. Finally, all data were compiled and prepared for analysis. This structured procedure ensures the consistency and validity of the research findings (McMillan, 2020).

5. Data Analysis Techniques

Quantitative data were analyzed using statistical techniques to determine the effectiveness of the intervention. Paired sample t-tests were used to compare pre-test and post-test scores within each group, while independent sample t-tests were used to compare differences between the experimental and control groups. These statistical methods are commonly used to evaluate the impact of educational interventions (Field, 2021).

Qualitative data obtained from interviews and observations were analyzed using thematic analysis to identify patterns and themes related to students' experiences and perceptions. The analysis process involved data coding, categorization, and interpretation to ensure meaningful insights. Data analysis was supported using statistical software such as SPSS for quantitative data and NVivo for qualitative data analysis (Braun & Clarke, 2021).

D. RESEARCH RESULT

This section describes the results of the study concerning the influence of Artificial Intelligence (AI) on personalized learning, student learning outcomes, and learning motivation. The findings are analyzed using both quantitative and qualitative approaches to obtain a deeper understanding of the effects of AI-assisted learning on students' educational experiences. Statistical analyses are used to present the quantitative results, while interview data from students provide additional insights to reinforce the interpretation of the findings. In addition, this section examines the role of student motivation as a mediating factor between AI integration and learning outcomes, emphasizing the wider impact of AI implementation in secondary education.

1. The Effect of Artificial Intelligence (AI) on Personalized Learning

The findings indicate that the implementation of Artificial Intelligence (AI) significantly enhances personalized learning among students in the experimental group. Students who participated in AI-assisted learning demonstrated higher adaptability in learning pace and improved interaction with learning materials compared to those in the control group. The AI system enabled students to receive immediate feedback, which supported their understanding of concepts more effectively. Additionally, students showed increased autonomy in managing their learning process, allowing them to take control of

their learning experience. These results clearly demonstrate that AI contributes positively to the development of personalized learning environments.

Table 1.
Differences in Personalized Learning Scores Between Groups

Group	Mean Score	Std. Deviation	Sig. (p-value)
Experimental	85.40	4.12	0.000
Control	72.15	5.03	

The results in Table 1 show that the experimental group achieved a significantly higher mean score compared to the control group, with a p-value < 0.05. This indicates a statistically significant difference in personalized learning outcomes. Therefore, H1 is accepted, confirming that Artificial Intelligence (AI) positively influences personalized learning.

To further strengthen these findings, qualitative data reveal how students experienced the flexibility of AI-based learning in a more personal and meaningful way. One student explained that learning became more adaptive to their ability: *"Learning feels more comfortable because I can follow my own pace, not too fast or too slow"* (S-03, Interview, January 2026). This perception is supported by another student who emphasized the clarity of AI explanations: *"AI really helps, I understand the material faster because it gives direct explanations"* (S-07, Interview, January 2026).

These responses collectively indicate that students not only benefited from adaptive pacing but also experienced improved clarity and understanding. In other words, AI does not merely support learning technically, but also transforms how students interact with knowledge. Thus, the findings strongly confirm that AI enhances personalized learning both quantitatively and experientially.

2. The Effect of Artificial Intelligence (AI) on Learning Outcomes

The analysis of pre-test and post-test scores shows a significant improvement in student learning outcomes in the experimental group compared to the control group. Students who used AI-assisted learning demonstrated better comprehension and higher academic achievement after the intervention. The improvement in scores reflects the effectiveness of AI in facilitating deeper understanding of the subject matter. Additionally, AI-based feedback mechanisms contributed to reducing learning gaps among students. These findings suggest that AI plays a crucial role in enhancing academic performance.

Table 2.
Pre-test and Post-test Comparison

Group	Pre-test Mean	Post-test Mean	Gain Score	Sig.
Experimental	68.20	86.50	18.30	0.000
Control	69.10	75.30	6.20	

Table 2 shows that the experimental group experienced a significantly higher gain score compared to the control group, with a p-value < 0.05. This confirms that the use of AI leads to a substantial improvement in student learning outcomes. Therefore, H2 is accepted.

In line with the quantitative findings, qualitative data provide deeper insights into how AI contributes to improved understanding. One student described how AI helps identify mistakes more clearly:

"When using AI, I understand better because it immediately shows where my mistakes are" (S-01, Interview, January 2026). This experience is further reinforced by another student who highlighted the impact on academic achievement: *"My scores improved because I can focus more and the material is clearer"* (S-05, Interview, January 2026).

These responses show that AI supports not only error correction but also enhances focus and comprehension. Students become more aware of their learning process, which ultimately leads to better performance. Therefore, the findings firmly emphasize that AI significantly improves learning outcomes through both cognitive support and improved learning strategies.

3. The Effect of Artificial Intelligence (AI) on Student Motivation

The findings reveal that AI-assisted learning significantly increases student motivation. Students in the experimental group showed higher levels of engagement, enthusiasm, and participation compared to those in the control group. The interactive features of AI-based learning systems encouraged students to be more actively involved in the learning process. Additionally, the personalized feedback provided by AI contributed to increased confidence and willingness to learn. These results demonstrate that AI positively influences student motivation.

Table 3.
Student Motivation Scores

Group	Mean Score	Std. Deviation	Sig.
Experimental	88.10	3.85	0.000
Control	74.25	4.67	

Table 3 shows that students in the experimental group obtained higher motivation scores than those in the control group. The statistical analysis revealed a p-value lower than 0.05, indicating that the difference between both groups is significant. These findings support the acceptance of Hypothesis 3 (H3).

Qualitative findings further illustrate how AI transforms students' emotional engagement in learning. One student expressed increased enjoyment during learning activities: *"Learning feels more fun, it's not boring like before"* (S-02, Interview, January 2026). This positive experience is echoed by another student who highlighted increased enthusiasm: *"I feel more motivated to learn because technology helps me"* (S-06, Interview, January 2026).

These responses suggest that AI creates a more enjoyable and stimulating learning environment. Students not only participate more actively but also develop a stronger interest in learning. Thus, the findings clearly reinforce that AI enhances student motivation by making learning more engaging, interactive, and meaningful.

4. The Mediating Role of Motivation

The results indicate that student motivation plays a mediating role in the relationship between AI and learning outcomes. Increased motivation among students in the experimental group contributed to better learning outcomes. Students who were more motivated tended to engage more actively with the AI-based learning system, leading to improved academic performance. This suggests that motivation acts as a key mechanism through which AI enhances learning outcomes.

Table 4.
Mediation Analysis

Variable	Beta	Sig.
AI → Motivation	0.65	0.000

Variable	Beta	Sig.
Motivation → Learning Outcomes	0.72	0.000

Table 4 shows that both relationships are statistically significant, indicating that motivation partially mediates the effect of AI on learning outcomes. Therefore, H4 is accepted.

Qualitative findings further clarify this relationship by showing how motivation drives learning behavior. One student explained how increased enthusiasm leads to better learning effort: *"Because I feel more motivated, I also study more seriously"* (S-04, Interview, January 2026). This is supported by another student who described how interest improves understanding: *"When I'm interested, it becomes easier to understand the material"* (S-08, Interview, January 2026).

These statements indicate that motivation acts as a bridge between AI usage and improved academic outcomes. When students feel interested and engaged, they are more likely to invest effort in learning. Therefore, the findings strongly confirm that motivation plays a crucial mediating role in enhancing the effectiveness of AI in improving learning outcomes.

E. CONCLUSION

This study concludes that the integration of Artificial Intelligence (AI) in learning significantly enhances students' learning outcomes, personalized learning experiences, and motivation. The quantitative findings demonstrate that students in the AI-assisted learning environment achieved higher academic performance compared to those in conventional learning settings. In addition, qualitative findings reveal that AI provides adaptive learning experiences, immediate feedback, and increased student engagement, which contribute to deeper understanding and more effective learning processes. Furthermore, student motivation was found to play a mediating role, indicating that the effectiveness of AI is strengthened through increased engagement and learning interest.

From an implementation perspective, the findings indicate that teachers should integrate AI-supported technologies into classroom activities to promote adaptive and personalized learning experiences.

Educational institutions are also encouraged to strengthen their digital infrastructure and provide adequate professional development for teachers in using AI effectively during instruction. Furthermore, policymakers need to support the advancement of technology-driven learning environments to ensure equal access and optimize the benefits of AI in the educational sector.

F. AUTHOR'S NOTE

The author declares that there is no conflict of interest in the publication of this article. The entire writing process was conducted independently and responsibly. The author also confirms that this article is free from plagiarism and was compiled in accordance with academic ethics and applicable scientific principles.

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