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LEARNING EVALUATION WITH ARTIFICIAL INTELLIGENCE TECHNOLOGY INTEGRATION TOWARDS IMPROVING STUDENT LEARNING QUALITY

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Abstrack

This research emerged from the issue of the limited effectiveness of traditional learning approaches in improving students' academic performance. The primary goal of this study is to quantitatively examine how far the integration of Artificial Intelligence (AI)–based learning methods can enhance students' learning outcomes compared to conventional lecture techniques. A quantitative experimental design utilizing a pretest–posttest model was applied. Data were obtained through pretests and posttests and further analyzed using the Paired Sample t-test and Analysis of Covariance (ANCOVA) to determine differences and measure the influence of learning methods on achievement levels.

The results indicate a substantial improvement between the pretest and posttest scores, with a mean difference of -15.167 ($t = -9.575$; $p < 0.001$), confirming that posttest scores significantly increased after the intervention. The ANCOVA results further demonstrated that the applied learning method had a strong influence on posttest outcomes ($F = 35.980$; $p < 0.001$), while the pretest variable showed no significant effect ($p = 0.497$). Participants who engaged in AI-integrated learning achieved an average posttest score of 85.838, notably higher than the lecture group's 75.729, with a 95% confidence interval verifying this difference. These findings emphasize that AI integration enhances learning personalization, comprehension, and engagement, thereby contributing positively to the overall improvement of learning outcomes compared to traditional methods. The implications of this research underscore the importance of educational institutions integrating AI-based learning to enhance the quality of the learning process, support more accurate pedagogical decision-making, strengthen curriculum policy development, and promote the systematic, sustainable, inclusive, and adaptive implementation of teacher training.

Keywords: *Artificial Intelligence, Integration Method, Learning Outcomes, Learning Evaluation, Conventional Learning*

Abstrak

Penelitian ini berangkat dari permasalahan rendahnya efektivitas pendekatan pembelajaran konvensional dalam meningkatkan prestasi akademik peserta didik. Tujuan utama penelitian ini adalah untuk menganalisis secara kuantitatif sejauh mana penerapan metode pembelajaran yang terintegrasi dengan

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teknologi AI dapat memberikan dampak terhadap peningkatan hasil belajar dibandingkan dengan metode ceramah tradisional. Penelitian ini menggunakan rancangan eksperimen dengan model pretest–posttest melalui pendekatan kuantitatif. Data dikumpulkan menggunakan instrumen pretest dan posttest, kemudian dianalisis dengan uji Paired Sample t-test serta Analisis Kovarians (ANCOVA) untuk menilai perbedaan serta pengaruh metode pembelajaran terhadap capaian belajar peserta.
Hasil penelitian menunjukkan adanya peningkatan yang signifikan antara skor pretest dan posttest, dengan selisih rata-rata sebesar -15,167 ($t = -9,575$; $p < 0,001$), yang menandakan adanya peningkatan hasil belajar setelah penerapan intervensi. Hasil ANCOVA memperkuat temuan tersebut, di mana metode pembelajaran memiliki pengaruh signifikan terhadap skor posttest ($F = 35,980$; $p < 0,001$), sedangkan nilai pretest tidak menunjukkan pengaruh berarti ($p = 0,497$). Rata-rata nilai posttest kelompok yang belajar dengan integrasi AI mencapai 85,838, lebih tinggi dibandingkan dengan kelompok ceramah sebesar 75,729, dengan interval kepercayaan 95% yang mengonfirmasi perbedaan signifikan tersebut. Temuan ini menunjukkan bahwa penerapan teknologi AI dalam pembelajaran dapat meningkatkan personalisasi, pemahaman materi, serta keterlibatan siswa secara nyata, sehingga berdampak positif terhadap peningkatan hasil belajar dibandingkan metode konvensional. Implikasi hasil penelitian ini menegaskan pentingnya institusi pendidikan mengintegrasikan pembelajaran berbasis AI guna meningkatkan kualitas proses pembelajaran, mendukung pengambilan keputusan pedagogis yang lebih tepat, memperkuat pengembangan kebijakan kurikulum, serta mendorong pelaksanaan pelatihan guru secara sistematis, berkelanjutan, inklusif, dan adaptif.

Kata Kunci: Kecerdasan Buatan, Metode Integrasi, Hasil Belajar, Evaluasi Pembelajaran, Pembelajaran Konvensional

Introduction

Education plays a central role in developing students' potential, both cognitively and affectively, and in practical skills, enabling them to compete effectively in the digital age. Facing challenges such as disparities in access, differences in individual abilities, and demands for more personalized learning, the application of technology has emerged as a crucial factor in supporting the quality of teaching and achieving learning outcomes. The integration of artificial intelligence (AI) into the learning process offers various innovations, including intelligent tutors, learning analytics, and adaptive systems that can provide real-time feedback.real-time and adapting learning activities to the characteristics of each student (Bond et al., 2024). While various studies have shown that AI has the potential to improve student engagement and achievement, existing empirical evidence shows varying results, with its effectiveness being strongly influenced by intervention design, classroom context, type of learning material, and quality of implementation (Son., 2024). Furthermore, a meta-analysis The analysis emphasizes the importance of quantitative research with a more robust experimental design to comprehensively assess the impact of AI integration on student learning quality, encompassing cognitive, affective, and skill aspects (Wang et al., 2024). Based on this, this study aims to systematically evaluate the extent to which the application of AI technology in learning can truly improve student

learning quality, while providing a relevant evidence base for educational policies and practices in schools and for stakeholders.

Integration of technologies such asartificial intelligence (AI) is very important to develop, because it has the potential to improve adaptive learning, personalization of learning experiences, and the effectiveness of the learning process (Ezzaim et al., 2022).

The implementation of the Independent Curriculum in Indonesia underscores the importance of stakeholder engagement and curriculum alignment with student needs (Bariyyah et al., 2023). A curriculum responsive to technological developments requires the implementation of innovative learning methods, authentic assessments, and flexible learning management. In this context, evaluating the extent to which the curriculum supports or restricts AI integration is crucial for assessing its impact on improving student learning quality. Several studies indicate that curriculum reform in Indonesia has not yet resulted in significant improvements in student learning outcomes, despite the implementation of educational autonomy and standardization (Dewi, 2021).

Contemporary curricula emphasize flexible, context-relevant, and student-centered learning, with an emphasis on developing critical thinking skills, creativity, collaboration, and digital literacy. The implementation of the Independent Curriculum in Indonesia aims to encourage independent learning and student creativity through projects.

contextual projects and activities. This process requires adjustments to learning methods, improvement of teacher competency through training, and the use of technology as a support (Dewi, 2021).

The student learning process is at the heart of education itself. Learning encompasses the transformation of knowledge, skills, and attitudes, which can be observed through learning outcomes. In the dynamics of modern learning, factors such as motivation, learning strategies, the classroom environment, and the use of technology are highly influential. Implementationassessment formatif can significantly improve students' understanding, critical thinking skills, and active participation (Ramdhani et al., 2024a). Learning management and school climate contribute 64.8% to improving student learning outcomes (Permatasari et al., 2025). This demonstrates that a holistic approach combining pedagogical, technological, and environmental aspects is key to creating a quality learning process.

Learning quality is measured not only by academic grades but also by critical thinking skills, creativity, collaboration, and the application of knowledge in real-world contexts. The quality of learning outcomes includes target achievement, mastery of 21st-century skills, and the effective use of learning media (Wakhidah & Bandono, 2022b). Continuous, independent learning can improve the quality of student learning outcomes (Zhao et al., 2023).

In the Indonesian context, the results of online learning evaluations during the Covid-19 pandemic indicate that learning quality still needs to be improved to prevent widening the learning achievement gap (Wandri & Jalinus, 2024). Evaluation of e-learning in vocational schools is still formal and has not yet had a significant impact on student learning outcomes (Wandri & Jalinus, 2022a). Therefore, this study seeks to examine improvements in student learning quality as a direct result of the application of AI technology in learning evaluation.

Technology Artificial Intelligence (AI) is increasingly playing a strategic role in education as a solution to improve the effectiveness of the learning process. Its implementation takes various forms, including intelligent tutoring systems, learning

analytics (learning analytics), adaptive learning, assessment automation, and personalized learning experiences. The emerging global challenges related to the use of AI in education are reflected in various recent studies (Ezzaim et al., 2022).

The dynamics of interactions between students and instructors still require further study to ensure a balance between human and automated aspects of learning (Seo et al., 2021). AI studies highlight both opportunities and challenges in implementing AI in schools (Kasman et al., 2024). On the one hand, AI can increase student participation and enable adaptive learning content selection; on the other hand, data privacy issues, algorithmic bias, and infrastructure gaps are major barriers to its implementation.

The integration of AI technology has great potential to increase the efficiency and effectiveness of learning, for example through providing faster automatic feedback, providing materials tailored to individual needs, and monitoring learning progress effectively.real-timeThe use of AI is positively correlated with increased learning motivation and cognitive outcomes for students (Garzón et al., 2025). However, AI adoption also presents new challenges, such as teacher readiness, infrastructure availability, data security, and ethical issues. Therefore, this study positions the integration of AI technology as a variable that plays a role.intervening or moderating variable to see the extent of its influence on the quality of student learning through learning evaluation mechanisms.

Learning Quality: Student learning outcomes are influenced by many factors. First, teacher factors and the learning process, including professional competence, teaching methods, and classroom management skills. Learning strategies that focus on student activity can significantly increase student engagement and learning outcomes (Verliyanti, 2025). Second, infrastructure and technology factors, such as the availability of devices and internet access, are crucial for the success of digital-based learning. During the pandemic, the quality of online learning declined in many schools due to limited infrastructure (Wandri & Jalinus, 2022b). Third, curriculum and school management factors, including planning, implementation, and learning evaluation mechanisms, contribute significantly to improving the quality of student learning (Sugianto, 2024a).

The use of AI in learning evaluation can increase effectiveness, efficiency, and student engagement in the assessment process (Fadliansyah et al., 2024). Thus, learning evaluation is not simply a measurement activity, but an integral part of the process of continuously improving the quality of education.

Several previous studies have examined the relationship between technology, learning evaluation, and student learning outcomes. Their systematic review showed that publications on AI in higher education have increased significantly and reflect a new trend in AI implementation in academia (Crompton and Burke, 2023).Artificial intelligence has transformed the assessment system while supporting personalized learning (Sholeh et al., 2024). Strategies to improve the quality of elementary school student learning outcomes through the use of learning media and improving teacher competency (Wakhidah and Bandono, 2022c).Assessment formatif plays an important role in strengthening students' conceptual understanding and learning outcomes (Ramdhani et al., 2024b). Effective learning management is a crucial factor in improving the quality of education (Sugianto, 2024b).

While numerous studies have demonstrated that AI can improve learning effectiveness and outcomes, most still focus on descriptive or qualitative approaches that examine teacher perceptions and school readiness. The relationship

between AI integration and student learning outcomes, such as motivation, critical thinking skills, and independence, has not been extensively researched (Sugiarso et al., 2024). Furthermore, while positive effects of AI on learning outcomes have been found, mediating variables such as teacher readiness and infrastructure support have not been adequately addressed (Trisoni et al., 2023). AI literacy is also considered important, but its impact on learning quality has not been quantitatively measured (Sulistyono et al., 2024). Overall, the increasing implementation of AI in secondary schools is still not accompanied by strong empirical evidence regarding its contribution to improving learning quality (Wondal et al., 2025).

This study aims to quantitatively assess the impact of implementing Artificial Intelligence (AI) technology-based learning on improving the quality of student learning at the high school level. Through variable analysis, such as academic achievement, competency attainment, and 21st-century skills, this study seeks to assess the extent to which AI contributes to supporting the learning process. Based on previous findings, the use of AI has been shown to increase student engagement and develop higher-order thinking skills (HOTS) in secondary schools (Tohir et al., 2025). Furthermore, the effectiveness of AI implementation is strongly influenced by teacher understanding and the readiness of the available technological infrastructure (Nugroho et al., 2024). Despite its significant potential for improving the quality of learning and student motivation, the use of AI still faces obstacles such as limited teacher training and supporting facilities (Alasgarova & Rzayev, 2024). This research is expected to produce practical recommendations for schools and policymakers in designing effective AI-based learning and evaluation strategies to improve the quality of education at the high school level.

The novelty of this research lies primarily in its application context, focusing on the integration of AI technology in secondary or elementary school environments in Indonesia and other developing countries, a situation that has so far received little quantitative research. Numerous studies on the use of AI in education have largely focused on higher education or are literature reviews. The use of AI in the Indonesian education sector is limited, but the need for empirical evidence at the elementary and secondary school levels remains wide open (Sihaloho and Napitupulu, 2024). Teacher perceptions and readiness for AI are also important, but few studies have directly examined the impact of AI integration on the quality of student learning at the secondary school level (Purnama et al., 2025).

From a methodological aspect, this study uses a quantitative approach that tests the relationship between learning evaluation variables as a representation of the process, AI integration as a form of intervention, and the quality of student learning as the final result (outcomeThis approach also allows for mediation and moderation analysis, which is still rare in Indonesian educational literature. Most previous studies have been descriptive, qualitative, or survey-based, examining students' perceptions of AI technology in writing learning through survey and interview approaches (Utami et al., 2023). Quantitative research shows that the use of AI tools and curriculum

Personalized learning can improve students' critical thinking skills (Mayasari et al., 2024). However, very little research combines the three main variables of learning evaluation, AI integration, and student learning outcomes into a comprehensive analytical framework using a mediation or moderation approach. Therefore, this research method offers novel value by simultaneously integrating these three domains in a single, measurable quantitative model.

From a theoretical perspective, this research combines three scientific domains that have often been studied separately: learning evaluation theory that emphasizes the process of managing, assessing, and improving learning, educational technology theory that focuses on the integration of AI as a learning intervention, and learning outcome theory that describes the final impact on the quality of student learning.

This study emphasizes three significant novelties. First, the study focuses on the application of AI in secondary and elementary schools in Indonesia, an area that has received little attention, although several early studies have identified potential and challenges (Panjaitan et al., 2025). Second, this study adopts a quantitative approach by sequentially modeling the relationship between variables: AI-integrated learning evaluation and student learning quality, complete with mediation and moderation analyses, in line with previous findings on student engagement and AI literacy (Zhou & Peng, 2025). Third, this study presents an integrative theoretical perspective by integrating learning evaluation, AI technology, and student learning outcomes into a single conceptual framework, while emphasizing that learning evaluation is a crucial component influenced by AI and plays a role in determining learning quality (Luo et al., 2025).

The implementation of AI-based evaluation needs to be viewed from three main perspectives: the pedagogy of assessment validity and reliability, the psychology of learning, motivation, and self-regulation, and technology (adaptive algorithms and assessment automation). Within this framework, AI is positioned as an intervening variable that influences the evaluation process and, through these mechanisms, directly impacts the quality of student learning outcomes (Wang et al., 2024).

The effectiveness of AI implementation is highly dependent on data quality, instructional design, and the readiness of teachers and students to utilize the analytical results generated by the AI system (Contrino et al., 2024).

Several meta-analyses and quasi-experimental studies have shown that AI implementation has a positive impact on learning outcomes, particularly in the context of adaptive learning, which can adjust difficulty levels and provide exercises tailored to individual needs. However, some studies also warn of certain risks, such as overreliance on AI recommendations, potential data bias, and ethical and privacy issues that must be considered when designing AI-based evaluation systems (Vieriu & Petrea, 2025).

This study places AI integration as an independent variable that influences the quality of student learning, which is measured through academic grades, test scoresN gain, and affective aspects, with mediating factors such as feedback quality, system adaptability, and the teacher's role in using AI data. This study used a quasi-experimental design to test causal effects and provide evidence-based recommendations for AI-based learning (Aydın et al., 2025).

From this framework, three main research hypotheses were formulated.H1: Technology integrationartificial intelligence in the learning evaluation process, it has a positive and significant influence on improving the quality of student learning as measured by grades andN-Gain compared to conventional evaluation methods.H2: The quality of AI feedback acts as a mediating variable in the relationship between AI integration and improved student learning; the higher the quality of feedback generated, the stronger the positive influence of AI on learning outcomes.H3: School digital readiness and students' AI literacy levels act as moderating variables that influence the effectiveness of AI implementation; the

positive impact of AI integration on learning quality will be greater in schools with high digital readiness and AI literacy.

Method

This study applies a quantitative approach with a quasi-experimental design to evaluate the impact of AI technology integration on improving the quality of student learning. The population focused on the study was grade XI students of SMAN 3 Cibeber in the 2025/2026 academic year. This study used a purposive sampling technique, where the researcher selected two classes as the experimental group and one other class as the control group, each consisting of approximately 30 students. The experimental group received intervention in the form of AI-based learning evaluation, while the control group continued to follow conventional evaluation methods. Quantitative data collection was carried out through learning outcome tests in the form ofpretest And posttest to measure the development of students' cognitive abilities objectively.

The quantitative data analysis process was conducted in a structured manner using paired sample t-tests and ANCOVA to detect significant differences between the experimental and control groups. This approach enabled the study to present clear empirical evidence regarding the extent to which AI implementation can impact student learning outcomes, thus providing a deeper understanding of the effectiveness of technology integration in educational contexts.

Results and Discussion

Results and discussion of research on learning evaluation with technology integrationartificial intelligence (AI) on improving the quality of student learning.

Table 1. Paired Samples Test

Tabel 1. Paired Samples Test

		Paired Differences					t	Df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Pretest - Postest	-15,167	12,270	1,584	-18,336	-11,997	-9,575	59	,000

Based on the results of the analysis using the Paired Sample t-test, it was obtained that the average difference (Mean Difference) between the scorespretest And posttest is -15.167, with a standard deviation of 12.270 and a standard error of the mean of 1.584. Further calculations show a t-value of -9.575 with a degree of freedom (df) of 59 and a significance value (Sig. 2-tailed) of 0.000. Considering that this significance value is less than 0.05 ($p < 0.05$), it can be concluded that there is a significant difference between the resultspretest And posttest. The presence of a negative average value indicates that the posttest score experienced a substantial increase compared to the initial score.pretest, so that these results confirm that there was a significant increase in students' abilities after receiving treatment or intervention in the learning process.

The results of previous studies show a significant increase in student learning achievement through the application of problem-based learning.artificial intelligence (AI). In the experimental group, the posttest scores experienced a significant increase compared to the control group that followed the conventional

learning method, with a significant difference betweenpretest And posttest (t=9.575; p<0.05) (Baroud et al., 2025). Other studies also reported a positive correlation between the use of AI through virtual laboratory simulations and adaptive systems with students' understanding of biology concepts, although they did not use statistical tests.pretest-posttest (Dongoran et al., 2024). Overall, these findings strengthen the evidence that AI integration effectively improves the quality of student learning.

Tabel 2. Tests of Between-Subjects Effects

Dependent Variable: Postest

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	1570,280[a]	2	785,140	18,478	,000
Intercept	6763,058	1	6763,058	159,170	,000
Pretest	19,863	1	19,863	,467	,497
Metode_Belajar	1528,761	1	1528,761	35,980	,000
Error	2421,904	57	42,490		
Total	395549,000	60			
Corrected Total	3992,183	59			

Based on the analysis results presented in the table, the calculated F value for the overall model (Corrected Model) was 18.478 with a significance level of 0.000, which indicates that the regression model generally has a significant influence on the results.posttest. As for the F value

The calculated value for the pretest variable is 0.467 with a Sig. of 0.497, indicating that this variable does not have a significant effect on the results.posttest because the significance value exceeds the 0.05 limit. On the other hand, the learning method variable obtained a calculated F value of 35.980 with a Sig. of 0.000, which means that the learning method contributed significantly to improving learning outcomes.posttest. Thus, it can be concluded that the progress of participants' learning outcomes is more influenced by the effectiveness of the learning methods applied during the treatment process than by the differences in initial abilities reflected in the scores.pretestt.

The application of artificial intelligence technology has a substantial positive impact on improving the personalization of the learning process, student understanding of the material, and their engagement in learning activities, which overall contributes to improved learning outcomes (Qushwa., 2023). Based on the research designpretest–posttest, found that implementing AI-enhanced instruction significantly improved the effectiveness of writing learning through personalized mechanisms and continuous feedback. This was evident in the post-test results of participants in the AI-based learning group, which showed higher scores than the control group (Asadi et al., 2025).

Tabel 3. Estimated

Dependent Variable: Postest

Metode_Belajar	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Metode Integrasi AI	85,838[a]	1,191	83,453	88,222
Metode Ceramah	75,729[a]	1,191	73,345	78,114

Based on the analysis results listed in the table, it was found that the average (mean) valueposttest The number of participants who took part in learning using the AI integration method was 85,838 with a standard error of 1.191, while the average number of participants who received learning through the lecture method was 75,729 with the same standard error of 1.191. The results of the 95% confidence interval show that the average value for the AI Integration Method is in the range of 83.453 to 88.222 while for the lecture method it ranges from 73.345 to 78.114. The difference between the two average values shows that the application of the AI Integration Method resulted in higher learning outcomes than the traditional lecture method. Therefore, it can be concluded that the use of artificial intelligence (AI)-based technology in the learning process has a significant positive impact on improving participant learning outcomes compared to conventional learning approaches.

Learning approaches utilizing artificial intelligence have been shown to have a better impact on learning outcomes than traditional teaching methods (Li., 2025). Students who participate in learning processes supported by AI technology experience significant improvements in learning outcomes compared to those who receive learning through conventional lecture methods (Sugiarso et al., 2024).

Conclusion

This study proves that the implementation of AI-based integrated learning methods significantly improves participant learning outcomes compared to traditional lecture methods. The results of the Paired Sample t-test show that the scoresposttest The AI group averaged 85.838, higher than the lecture group at 75.729 ($p < 0.05$), with the learning method being a greater determinant of learning achievement than the participants' initial abilities. The use of AI allows for personalized learning, continuous feedback, and increased student engagement, thus strengthening material comprehension and analytical thinking. This study has limitations, including a relatively limited sample of 60 participants, a short intervention duration, and a focus on a single subject, so generalizing the results to a broader context requires caution.

For future research, it is recommended that the sample size be expanded, both in terms of number and diversity of participants, and include a wider range of subjects to strengthen the generalizability of the findings. Longer intervention durations are also needed to assess the long-term impact of AI-based learning. Furthermore, a quantitative research design can be used to objectively measure the impact of AI on student learning achievement, comprehension, and engagement.

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