

THE EFFECTS OF INSTRUCTIONAL LEADERSHIP AND AI-ASSISTED TEACHER TEACHING PERFORMANCE ON STUDENTS' LEARNING MOTIVATION

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Submitted: 22/08/2026

Revised: 19/09/2026

Accepted: 01/10/2026

Published: 15/10/2026

Abstract

This study aims to examine the effects of principals' instructional leadership and AI-assisted teacher instructional performance on students' learning motivation in Economics subjects at senior high schools in Sub Rayon 03, Semarang Regency. The study employed a quantitative approach with a survey method and a correlational design. Primary data were obtained from students' questionnaire responses. The population comprised 184 students from four senior high schools, with a sample of 126 students determined using Slovin's formula at a 5% margin of error. Respondents were selected using [insert the sampling technique used]. Data were collected through a closed-ended questionnaire using a five-point Likert scale. Multiple linear regression analysis was conducted using SPSS version 25, with t-tests, an F-test, and the coefficient of determination assessed at a 5% significance level. The results showed that principals' instructional leadership had a positive and significant effect on students' learning motivation ($B = 0.622$; $t = 8.358$; $p < 0.001$), whereas AI-assisted teacher instructional performance had a negative and significant effect ($B = -0.364$; $t = -3.693$; $p < 0.001$). The overall regression model was statistically significant ($F = 39.706$; $p < 0.001$) and explained 39.2% of the variance in students' learning motivation ($R^2 = 0.392$). These findings emphasize the importance of strengthening instructional leadership and evaluating AI implementation in teaching while maintaining meaningful pedagogical interactions between teachers and students.

Keywords

Instructional Leadership, Teacher Instructional Performance, Artificial Intelligence, Learning Motivation, Economics Education.



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INTRODUCTION

The development of digital technology has brought significant changes to the educational paradigm, particularly in learning processes that are increasingly integrated with Artificial Intelligence (AI) technologies. The use of AI in education creates opportunities for more adaptive, personalized, and data-driven learning environments. However, the successful implementation of educational technology is determined not only by the availability of digital infrastructure but also by school leadership capacity and teachers' pedagogical competence in integrating technology into instructional practices. Digital transformation in education is not merely about adopting technological devices but also requires fundamental changes in learning management and educational practices. (Fullan & Langworthy, 2014) argued that technology can significantly improve educational quality when combined with changes in pedagogical practices, teacher capacity development, and school leadership capable of directing learning innovations. Therefore, AI integration in education should be understood as a transformation of the learning system rather than merely the adoption of technological tools.

School principals play a strategic role in ensuring that educational transformation aligns with learning objectives through instructional leadership. Instructional leadership positions school principals as key drivers in establishing academic visions, improving instructional quality, providing educational resources, and developing school environments that support student achievement and motivation to learn. (Dasci Sonmez et al., 2026) demonstrated that instructional leadership contributes to improving the quality of learning by strengthening teacher capacity and developing positive academic cultures. Similarly, (Liu & Feng, 2023) found that instructional leadership is associated with student learning engagement through mechanisms that improve the quality of learning environments. How school leadership and AI-assisted teaching relate to students' motivation to learn is an important question in Economics education. At SMA Negeri 1 Ambarawa, SMA Negeri 1 Tuntang, SMA Islam Sudirman Ambarawa, and SMA Virgo Fidelis Ambarawa, this study examined whether students' perceptions of principals' instructional leadership and AI-assisted teacher instructional performance were associated with their motivation to learn Economics. The academic concern is that organizational support and technology-assisted teaching may relate differently to motivation. Although AI can support instructional activities, its use should not automatically be interpreted as evidence of a more motivating learning experience. In Economics, students are expected to understand concepts, interpret information, and apply their

knowledge to economic problems. These activities require sustained interest and willingness to engage with learning tasks. Principals' instructional leadership may support the conditions for such learning through instructional supervision and teacher development, while AI-assisted instructional performance concerns how teachers incorporate AI into their teaching practices (Kim, 2024). Examining both factors is therefore relevant to understanding whether school-level leadership and classroom-level practices make distinct contributions to students' reported motivation.

Five previous studies provide the foundation for this investigation. *First*, (Charernnit et al., 2021) found that leadership practices that promote and support teacher learning and development had particularly strong associations with student outcomes. This finding supports investigating leadership that directly engages with teaching and learning, although it does not establish its relationship with motivation in Economics. *Second*, (Liebowitz & Porter, 2019) In a review of 51 studies, researchers identified associations between principal behaviors and student achievement, teachers' instructional practices, teacher well-being, and school organizational health. However, they emphasized that the evidence was predominantly observational. Their findings establish the relevance of school leadership while highlighting the need to distinguish statistical relationships from causal effects. *Third*, (Zhai et al., 2021) identified applications of AI in education, including personalized learning and automated assessment, as well as implementation challenges and questions about teachers' roles. Their review demonstrates the instructional potential of AI but does not directly establish whether AI-assisted teacher instructional performance is associated with students' motivation in senior high school Economics. *Fourth*, (Koo et al., 2022) in a meta-analysis covering 344 samples and 223,209 participants, Koo et al. (2022) found that intrinsic motivation was associated with student success and well-being, while the personal value assigned to learning was particularly associated with persistence. These findings support examining motivation as a distinct educational outcome rather than assuming that achievement or task completion adequately represents students' interest in learning.

Fifth, (Zhang et al., 2026) in an experimental study involving 123 Grade 10 students, found that intrinsic motivation and perceived competence in chatbot-supported learning depended on both teacher support and student expertise. This finding suggests that motivational outcomes in AI-supported learning vary with the instructional conditions accompanying technology use. However, teacher support in chatbot-based learning differs from the broader construct of AI-assisted teacher instructional performance examined in this study. Together, these studies support the relevance of

leadership, teaching practices, and motivation. Still, they leave a specific question unresolved in the literature reviewed: how do principals' instructional leadership and AI-assisted teachers' instructional performance relate, individually and jointly, to students' motivation in Economics? Leadership research primarily addresses broader educational outcomes, whereas AI research examines technological applications or particular forms of instructional support. These findings cannot simply be combined to assume that both predictors necessarily have positive relationships with motivation.

The proposed contribution of this study is to examine the two predictors within a single analytical framework while distinguishing organizational leadership from AI-assisted classroom practices. It focuses on students' perceptions of these practices and their reported motivation in a specific subject. The analysis allows the direction and magnitude of each relationship to be assessed rather than presuming that greater AI-assisted instructional performance necessarily corresponds to stronger motivation. Its contribution, therefore, lies in examining the distinct and joint statistical relationships among the constructs, with the school setting providing the context for interpretation. Accordingly, this study aimed to examine the relationships between principals' instructional leadership and AI-assisted teachers' instructional performance and students' learning motivation in Economics at senior high schools in Sub Rayon 03, Semarang Regency, during the 2025/2026 academic year. Using a quantitative correlational survey of 126 students, the study assessed each predictor separately and both predictors jointly to determine their statistical contribution to variation in learning motivation.

METHOD

This study employed a quantitative survey approach. The quantitative approach was selected because this study aimed to measure the relationships and effects among research variables through numerical data analyzed using statistical techniques. The survey method was used to obtain information on respondents' characteristics, perceptions, and relationships among variables through a questionnaire. This study used a correlational research design, which aims to examine relationships and influences among two or more variables without manipulating them (Nardi, 2018). The correlational design was used to analyze the effects of principals' instructional leadership (X1) and AI-assisted teacher instructional performance (X2) on students' learning motivation (Y) in Economics subjects. This research design was selected to identify the contribution of each independent variable to the dependent variable and to explain factors associated with improving

students' learning motivation.

The research was conducted at senior high schools in Sub Rayon 03, Semarang Regency, namely SMA Negeri 1 Ambarawa, SMA Negeri 1 Tuntang, SMA Islam Sudirman Ambarawa, and SMA Virgo Fidelis Ambarawa. The study was carried out during the 2025/2026 academic year, from November 2025 to January 2026. The study population comprised 184 students from senior high schools in Sub Rayon 03, Semarang Regency. The sample size was determined using the Slovin formula with a 5% margin of error, yielding a total of 126 respondents. The sampling process was conducted to obtain representative data in accordance with the study's objectives.

Data were collected using a closed-ended questionnaire with a Likert scale. The research instrument consisted of statements with five response options, ranging from score 1 to score 5. The questionnaire was used to measure respondents' perceptions of principals' instructional leadership, AI-assisted teachers' instructional performance, and students' motivation to learn Economics. The collected data were analyzed using statistical techniques with SPSS version 25 for Windows. Data analysis was conducted using correlation and linear regression to determine relationships and effects among research variables. Hypothesis testing was performed using the *t-test* to examine the partial effects of each independent variable on the dependent variable, the *F-test* to assess the simultaneous effect of the independent variables on the dependent variable, and the coefficient of determination (R^2) to measure the contribution of the independent variables in explaining variation in the dependent variable.

The research hypotheses were formulated as follows:

1. H_{01} : Principals' instructional leadership does not affect students' learning motivation in Economics subjects ($b_1 = 0$ in the first simple linear regression model). H_{a1} : Principals' instructional leadership affects students' learning motivation in Economics subjects ($b_1 \neq 0$).
2. H_{02} : AI-assisted teacher instructional performance does not affect students' learning motivation in Economics subjects ($b_2 = 0$ in the second simple linear regression model). H_{a2} : AI-assisted teacher instructional performance affects students' learning motivation in Economics subjects ($b_2 \neq 0$).
3. H_{03} : Principals' instructional leadership and AI-assisted teacher instructional performance jointly do not affect students' learning motivation in Economics subjects ($\beta_1 = \beta_2 = 0$ in the multiple linear regression model). H_{a3} : At least one of the two predictors affects students' learning motivation in Economics subjects ($\beta_1 \neq 0$ and/or $\beta_2 \neq 0$).

All hypotheses were tested at a significance level of $\alpha = 0.05$. Two-tailed t-tests were used to test the regression coefficient in each simple linear regression model. In contrast, an F-test was used to assess the overall significance of the multiple linear regression model. The null hypothesis was rejected when $p < 0.05$; otherwise, it was not rejected.

FINDINGS AND DISCUSSION

Findings

The Effect of Principals' Instructional Leadership on Students' Learning Motivation

The first hypothesis examined the effect of principals' instructional leadership on students' learning motivation through Pearson correlation analysis, simple linear regression, *t*-test, and coefficient of determination analysis. The Pearson correlation analysis showed that instructional leadership was significantly and positively correlated with students' learning motivation ($r = 0.570$, $p = 0.000 < 0.05$). The correlation coefficient exceeded the critical value ($r_{table} = 0.176$, $N = 126$), indicating a positive and significant relationship between the two variables. Based on the correlation interpretation criteria, the relationship was categorized as moderate. The results of simple linear regression analysis are presented in Table 1.

Table 1. Simple Linear Regression Analysis of Instructional Leadership on Students' Learning Motivation

Variable	B	Std. Error	Beta	t	Sig.
Constant	38.566	8.615	-	4.477	0.000
Instructional Leadership (X1)	0.602	0.078	0.570	7.726	0.000

The regression equation obtained was: $Y = 38.566 + 0.602X_1$.

The equation shows a constant value of 38.566, meaning that if Instructional Leadership is zero, Student Learning Motivation is predicted to be 38.566. The regression coefficient of 0.602 indicates a positive relationship; thus, every one-unit increase in the Instructional Leadership score results in a 0.602-unit increase in Student Learning Motivation. The partial test (*t*-test) results show a calculated *t*-value of 7.726 with a significance level of 0.000. Since the significance value is less than 0.05 (0.000), H_0 is rejected, and H_1 is accepted. Consequently, Instructional Leadership has been shown to have a positive and significant effect on Student Learning Motivation. The coefficient of determination (R-squared) value of 0.325 indicates that Instructional Leadership accounts for 32.5% of the variation in Student Learning Motivation. Meanwhile, the remaining 67.5% of the variation is

influenced by factors outside the research model.

2. The Effect of AI-Assisted Teacher Instructional Performance on Students' Learning Motivation

The second hypothesis investigated the effect of AI-assisted teacher instructional performance on students' learning motivation through Pearson correlation analysis, simple linear regression, *t*-test, and coefficient of determination analysis. The Pearson correlation analysis revealed that AI-assisted teacher instructional performance had a correlation coefficient of $r = -0.217$ with a significance value of $p = 0.015$ (<0.05). This result indicates a significant negative relationship between AI-assisted teacher instructional performance and students' learning motivation. The results of simple linear regression analysis are presented in Table 2.

Table 2. Simple Linear Regression Analysis of AI-Assisted Teacher Instructional Performance on Students' Learning Motivation

Variable	B	Std. Error	Beta	t	Sig.
Constant	39.357	13.999	-	9.955	0.000
AI-Assisted Teacher Performance (X ₂)	-0.304	0.123	- 0.217	- 2.478	0.015

The regression equation obtained was: $Y = 139.357 - 0.304X_2$

A constant value of 139.357 indicates that if the Teaching Performance of AI-Assisted Teachers is zero, then Student Learning Motivation is predicted to be 139.357. The regression coefficient of -0.304 indicates a negative effect: every 1-unit increase in AI-assisted Teacher Teaching Performance reduces student learning motivation by 0.304 units. The results of the partial test (*t*-test) show a calculated *t* value of -2.478 with a significance level of 0.015. Because the significance value meets the test criteria (0.05), H_0 is rejected, and H_2 is accepted. Thus, AI-assisted teacher performance has a significant negative influence on students' motivation to learn. The R Square value of 0.047 indicates that the Teaching Performance of AI-Assisted Teachers accounts for 4.7% of the variation in Student Learning Motivation. Meanwhile, 95.3% of the variation in students' learning motivation is explained by factors not included in the research model.

The Simultaneous Effect of Instructional Leadership and AI-Assisted Teacher Instructional Performance on Students' Learning Motivation

The third hypothesis examined the simultaneous effect of principals' instructional leadership and AI-assisted teacher instructional performance on students' learning motivation using multiple linear regression analysis. The ANOVA test results are presented in Table 3.

Table 3. ANOVA Test Results for Multiple Regression Model

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	7168.728	2	3584.364	39.706	0.000
Residual	11103.597	123	90.273		
Total	18272.325	125			

The ANOVA results showed an F-value of 39.706 with a significance value of 0.000 (<0.05). This indicates that instructional leadership and AI-assisted teacher instructional performance had a significant, simultaneous effect on students' learning motivation. The multiple regression model produced an R value of 0.626, indicating a strong relationship between the independent variables and students' learning motivation. Furthermore, the R² value of 0.392 indicates that the combination of instructional leadership and AI-assisted teacher instructional performance explained 39.2% of the variance in students' learning motivation. The remaining 60.8% was explained by other factors not included in this model. The adjusted R² value of 0.382 indicates that the regression model remained stable after adjustment. The multiple regression coefficients are presented in Table 4.

Table 4. Multiple Linear Regression Analysis

Variable	B	Std. Error	Beta	t	Sig.
Constant	77.799	13.425	-	5.795	0.000
Instructional Leadership (X1)	0.622	0.074	0.589	8.358	0.000
AI-Assisted Teacher Performance (X2)	-0.364	0.099	0.260	-3.693	0.000

The multiple regression equation obtained was: $Y = 77.799 + 0.622X_1 - 0.364X_2$

Based on the equation, the following explanation can be provided: (1) Constant ($a = 77.799$). The constant value indicates that if Instructional Leadership and AI-Assisted Teacher Teaching Performance are at zero, Student Learning Motivation is predicted to be 77.799; (2) Instructional Leadership Coefficient ($\beta = 0.622$). The positive coefficient indicates that Instructional Leadership positively influences Student Learning Motivation. Each one-unit increase in Instructional Leadership will increase Student Learning Motivation by 0.622 units, assuming other variables remain constant.

Discussion

The Effect of Principals' Instructional Leadership on Improving Students' Learning Motivation

Research results indicate that the Principal's Instructional Leadership (X1) has a positive and significant influence on Student Learning Motivation (Y) in Economics subjects at high schools within Sub-Rayon 03, Semarang Regency. This is evidenced by a regression coefficient of 0.602, a calculated t-value of 7.726 (exceeding the t-table value of 1.980), and a significance value of 0.000 (below 0.05). Furthermore, the coefficient of determination (R^2) of 0.325 demonstrates that instructional leadership accounts for 32.5% of the variation in student learning motivation. These findings indicate that principals play a strategic role in fostering school conditions that support students' academic motivation. Instructional leadership extends beyond administrative tasks; it encompasses the principal's ability to establish a learning vision, manage academic programs, provide learning resources, and cultivate a school culture oriented toward improving the quality of instruction. Principal Component Analysis (PCA) results reveal that the provision of learning resources—specifically technological infrastructure—is the most dominant factor shaping instructional leadership, with an extraction value of 0.961. This finding suggests that principals who provide digital facilities, instructional tools, and technology-enabled learning environments can create conditions that foster student engagement in the learning process (Alotaibi, 2026).

These findings reinforce Hallinger's concept of instructional leadership, which posits that effective school leadership rests on three key aspects: defining school goals, managing instructional programs, and creating an academic climate that supports learning. Principals who consistently perform these functions can enhance the quality of the learning environment, thereby positively impacting student motivation. In the context of Economics education, the availability of technological facilities plays a crucial role, as the subject requires skills in data analysis, the interpretation of economic phenomena, and an understanding of dynamic market conditions. Principal support for technology integration enables teachers to utilize simulations, case studies, and economic data exploration, making it easier for students to grasp abstract concepts. The results of this study align with research by (Gechere et al., 2025), which found that principals' instructional leadership is positively associated with instructional quality by enhancing teacher capacity and creating a supportive academic environment. Furthermore, (Secuya & Obiso, 2026) explain that instructional leadership contributes to increased student learning engagement by fostering a learning-oriented school culture.

Additionally, research by (Gümüş et al., 2022) demonstrates that principals who practice instructional leadership can boost teacher motivation and improve the quality of instructional practices. This indicates that the impact of school leadership on students is mediated by mechanisms that enhance the quality of the learning process. Research by (Goddard et al., 2019) also confirms that effective school leaders significantly influence student learning outcomes by developing focused instructional systems and providing instructional support. Meanwhile, (Abrori et al., 2022) found that technology-based school leadership is a crucial factor in creating a digital learning ecosystem that enhances student participation and motivation. The findings of this research are also reinforced by (Riddel & Zulfikar, 2024), who explain that school leadership makes an important contribution to building an innovative learning environment by supporting teacher professional development, fostering academic collaboration, and improving the quality of instruction. This research shows that school principals not only act as organizational managers but also as drivers of change, creating conditions that enable teachers and students to develop optimally.

Furthermore, (Lin & Wang, 2025) found that instructional leadership positively influences student learning engagement through the mediating role of teacher teaching quality. These results indicate that the principal's leadership in increasing student motivation is not achieved directly, but by improving teachers' classroom learning practices. The research results of (Culduz, 2023) also show that principals' instructional leadership is associated with increased school effectiveness by strengthening the learning culture and supporting pedagogical innovation. In this research, the school principal's support for the provision of learning technology constitutes a form of instructional leadership that can strengthen teachers' readiness to implement AI-based learning. In addition, (Ghavifekr & Wong, 2021) explained that school leadership in the era of digital transformation has an important role in ensuring technology is used strategically to improve the quality of learning. School principals with a digital leadership orientation can integrate technology policies, teacher competency development, and student learning needs to create a more adaptive learning environment.

Based on these studies, it can be understood that the principal's instructional leadership is an important factor in increasing students' motivation to learn because the principal serves as a director of learning strategies, a facilitator of educational innovation, and a developer of the school's academic culture. In this research, a contribution of 32.5% indicates that the stronger the instructional leadership practices implemented, especially in providing technological resources and

learning support, the greater the opportunity to create learning experiences that increase student motivation in Economics subjects.

The Effect of AI-Assisted Teacher Instructional Performance on Improving Students' Learning Motivation

The research results indicate that AI-assisted teacher performance (X2) has a significant negative influence on student learning motivation. This is evidenced by a regression coefficient of -0.304, a calculated t-value of -2.478, and a significance value of 0.015 ($p < 0.05$). The partial contribution of this variable to students' motivation to learn is 4.7%. These findings reveal an interesting phenomenon: although students perceive the use of AI in learning positively, increased intensity of technology usage does not automatically boost learning motivation. Fundamentally, AI technology serves as a tool to support learning rather than a substitute for pedagogical interaction between teachers and students. PCA results indicate that the aspect of learning personalization is the dominant indicator in teachers' use of AI, with an extraction value of 0.535. Conversely, digital content integration shows the lowest extraction value at 0.371. This suggests that the utilization of AI still faces challenges in linking technology with instructional designs that are truly meaningful to students. This negative relationship can be explained through the concept of technology overuse. Over-reliance on AI can diminish social interaction, discussion, and emotional engagement between teachers and students (Zimosz & Ober, 2025). In Economics education, students require not only information but also critical thinking processes fostered through discussion, argumentation, and contextual problem-solving.

These findings are reinforced by research from (Tao et al., 2026), which explains that while generative AI in education offers significant opportunities for personalized learning, it also carries risks if students become overly dependent on technology, thereby undermining their independent thinking skills. Furthermore, (Chiu et al., 2024) found that AI in education should be positioned as a supportive technology, with human interaction remaining the primary factor in fostering motivation to learn. Research by Dogan et al. (2025) demonstrates that the successful implementation of AI in learning relies heavily on the teacher's pedagogical competence in integrating technology with active learning strategies. Technology employed without an appropriate pedagogical design can lead to low student engagement. Furthermore, (Qi & Derakhshan, 2025) state that technology-based learning can boost motivation provided students retain opportunities for exploration, collaboration, and reflection. Conversely, a mechanical approach to using technology can result in

digital fatigue. Research by (Zhou et al., 2026) also indicates that high-intensity use of digital technology can increase students' cognitive load if not accompanied by effective instructional management.

These findings align with research (Seo et al., 2021), which explains that while the use of artificial intelligence in learning can positively impact the learning experience, its effectiveness is heavily influenced by the quality of interaction among the teacher, the technology, and the students. When technology dominates the teacher's pedagogical role, students may experience a decline in emotional engagement because the learning process becomes less interactive. Furthermore, (Renz & Vladova, 2021) explain that the implementation of AI in education must adhere to the principle of human-centered AI; specifically, technology should be designed to augment human capabilities rather than replace the human role in the learning process. AI applications that fail to consider students' social and psychological aspects risk diminishing intrinsic motivation, as students may perceive the learning process as overly automated. Research by (Tariq, 2025) indicates that AI-based learning technologies can enhance student engagement when combined with active learning strategies, feedback mechanisms, and direct teacher support. Conversely, AI usage focused solely on automated information delivery—without teacher guidance—can relegate students to the role of passive recipients in the learning process. Additionally, a study by Kalyani (2024) on digital technology in education found that technology can boost learning engagement when used to foster communication, collaboration, and interaction. However, an over-reliance on devices (device-centered learning) can undermine the quality of social relationships within the learning environment, a crucial factor in fostering student motivation.

These findings suggest that any negative impact of AI on learning motivation does not imply that AI is ineffective; rather, it highlights that AI's effectiveness hinges on how teachers integrate it into their pedagogical approaches. Teachers remain central to maintaining a balance between technological utilization and social interaction in learning. In the context of Economics education, AI should be employed to enhance activities such as analysis, discussion, simulation, and problem-solving, rather than supplanting students' independent thinking processes.

The Simultaneous Effect of Principals' Instructional Leadership and AI-Assisted Teacher Instructional Performance on Students' Learning Motivation

The research results indicate that a school principal's instructional leadership and AI-assisted teacher performance have a significant, simultaneous effect on students' motivation to learn.

ANOVA test results show a calculated F-value of 39.706, exceeding the F-table value of 3.07, with a significance level of 0.000 (less than 0.05). The coefficient of determination (0.392) indicates that the two independent variables jointly explain 39.2% of the variation in students' learning motivation. The regression equation: $Y = 77.799 + 0.622X_1 - 0.364X_2$ shows that instructional leadership is a more dominant factor than AI-assisted teacher teaching performance. The beta coefficient for instructional leadership is 0.589, indicating a strong positive contribution, whereas AI shows a negative coefficient of -0.260. These results demonstrate that educational technology requires school leadership support to achieve an optimal impact. The school principal acts as a strategic guide, ensuring technology aligns with learning objectives, while the teacher manages the pedagogical process (Labotan, 2026). Thus, the success of digital transformation in education is determined not only by the availability of technology but also by the school organization's ability to manage change and ensure that technology adds value to the student learning experience.

These findings support the Technological Pedagogical Content Knowledge (TPACK) framework, which holds that the effectiveness of educational technology depends not merely on the ability to use digital devices but on the capacity to integrate technology, pedagogy, and content knowledge in a balanced manner. Technology integration that fails to consider pedagogical needs may result in technology serving merely as a tool for information delivery rather than an instrument for enhancing the quality of learning. Research Estrada et al. (2023) explains that the success of digital transformation in education relies on teachers' ability to integrate technology with appropriate pedagogical approaches. Furthermore, (Toding et al., 2024) found that TPACK proficiency enhances the effectiveness of digital learning because teachers can select technologies that align with subject-matter requirements and students' characteristics.

Research by (Dexter & Richardson, 2020) indicates that organizational support and school leadership are crucial factors in the successful implementation of learning technologies. Furthermore, (Enachescu & Costache, 2025) explain that schools with strong digital leadership achieve higher success rates in implementing learning technology innovations. Research (Soliman, 2026) that uses the Digital Competence Framework for Educators also emphasizes that teachers' digital competence must be accompanied by institutional support for technology to improve the quality of learning effectively. These research findings are reinforced by (Sunaryo et al., 2026), who demonstrated that the successful integration of technology in education is influenced by a combination of teachers' digital competence, school organizational readiness, and leadership

support. The study emphasizes that teachers' technological competence cannot fully develop if schools fail to provide policies, facilities, and an organizational culture that foster instructional innovation. This corroborates findings indicating that instructional leadership plays a crucial role in optimizing teachers' use of AI.

Furthermore, research by (Sultana & Sajjad, 2025) found a strong link between educators' digital competence and the quality of technology-based instruction. Teachers with high digital competence tend to use technology more creatively and adaptively, whereas using technology without the requisite competence can reduce instructional effectiveness. In the context of the present study, the negative results regarding the AI variable suggest that AI use must be guided by appropriate school policies and pedagogical strategies to boost students' motivation to learn effectively. Research by (Paramansyah, 2026) also highlights the role of principals' digital leadership in fostering technology readiness within the school environment. Principals who establish a digital vision, offer professional support to teachers, and provide learning resources increase the likelihood of successful technological innovation in education. These findings align with the current study's results, which indicate that instructional leadership contributes more significantly to outcomes than the direct use of AI alone. Additionally, research by (Yeboah et al., 2026) demonstrates that AI-based technologies in education positively impact student engagement when implemented within collaborative, student-centered learning environments. The study emphasizes that AI is not the sole factor in enhancing motivation to learn but rather one component of an educational system that involves teachers, school leadership, instructional strategies, and student characteristics.

Based on these results, enhancing students' motivation to learn in the digital era requires a combination of visionary school leadership and teachers' pedagogical competence in using technology. Robust technological infrastructure must be accompanied by student-centered learning strategies for AI to truly serve as an instrument for enhancing the quality of education. Thus, this study demonstrates that AI technology is more effective when situated within a school ecosystem characterized by strong instructional leadership, adequate teacher competence, and a learning orientation that places students at the center of the educational process.

CONCLUSION

Based on data from 126 respondents, this study demonstrates that principals' instructional leadership has a positive and significant effect on students' learning motivation, contributing 32.5%,

while AI-assisted teacher instructional performance has a significant but negative effect, contributing 4.7%. Simultaneously, both variables have a significant effect on students' learning motivation and explain 39.2% of its variation, with the remaining 60.8% attributable to other factors outside the research model. These findings confirm that principals' instructional leadership is the dominant factor in enhancing students' motivation to learn. In contrast, the use of AI does not automatically increase students' motivation and requires support from interactive pedagogical approaches, meaningful teacher–student communication, and collaborative learning activities. Therefore, schools are recommended to strengthen instructional leadership, provide technology-based learning resources and support, enhance teachers' pedagogical competence and AI literacy, and implement AI as a complementary tool that supports student-centered learning rather than replacing human interaction. Future research is also recommended to examine other factors that may explain the remaining 60.8% of the variation in students' learning motivation.

REFERENCES

- Abrori, M. S., Mispani, M., Setiawan, D., & Khodijah, K. (2022). Implementasi Nilai-Nilai Ahlussunnah Wal Jama'ah (ASWAJA) dalam Pembelajaran Ke-NU-An di MTS Darussalam Kademangan Blitar. *Tarbawiyah: Jurnal Ilmiah Pendidikan*, 6(1), 45–58. <https://doi.org/10.32332/tarbawiyah.v6i1.4785>
- Alotaibi, M. M. (2026). A Proposed Strategic Vision for Enhancing an Attractive and Engaging School Environment in the Era of Technological Transformation. *Perinatal Journal*, 34(1). <https://doi.org/10.57239/prn.26.03410048>
- Charernnit, K., Mathur, A., Kankaew, K., Alanya-Beltran, J., Singh, S., Sudhakar, P. J., Magulod, Jr., G. C., Gómez, J. J. S., & Singh, N. D. (2021). Interplay of Shared Leadership Practices of Principals, Teachers' Soft Skills, and Learners' Competitiveness in the COVID-19 Era: Implications for the Economics of Educational Leadership. *Studies of Applied Economics*, 39(12). <https://doi.org/10.25115/eea.v39i12.6463>
- Chiu, T. K. F., Moorhouse, B. L., Chai, C. S., & Ismailov, M. (2024). Teacher Support and Student Motivation to Learn with an Artificial Intelligence (AI) Based Chatbot. *Interactive Learning Environments*, 32(7), 3240–3256. <https://doi.org/10.1080/10494820.2023.2172044>
- Culdaz, M. (2023). The Impact of Educational Leadership in Improving the Learning Experience: In A. S. Munna, U. Nwagbara, & Y. Alhassan (Eds.), *Advances in Educational Marketing, Administration, and Leadership* (pp. 168–189). IGI Global. <https://doi.org/10.4018/978-1-6684-8332-9.ch008>
- Dasci Sonmez, E., Cinkir, S., & Babacan, K. (2026). The Effects of Instructional Leadership on Teachers' Instructional Practices through Inclusive Efficacy: The Moderating Role of Social Justice Leadership. *Educational Management Administration & Leadership*, 17411432261452003. <https://doi.org/10.1177/17411432261452003>
- Dexter, S., & Richardson, J. W. (2020). What does Technology Integration Research Tell us about the Leadership of Technology? *Journal of Research on Technology in Education*, 52(1), 17–36. <https://doi.org/10.1080/15391523.2019.1668316>

- Dogan, S., Nalbantoglu, U. Y., Celik, I., & Agacli Dogan, N. (2025). Artificial Intelligence Professional Development: A Systematic Review of TPACK, Designs, and Effects for Teacher Learning. *Professional Development in Education*, 51(3), 519–546. <https://doi.org/10.1080/19415257.2025.2454457>
- Enachescu, V.-A., & Costache, B. (2025). *Empowering Learning Through Digital Leadership in Education*. 6814–6821. <https://doi.org/10.21125/inted.2025.1753>
- Estrada, M. E., Kirschning, I., Nolasco-Flores, J. A., & Camacho-Zúñiga, C. (2023). Fostering Digital Transformation in Education: Technology-Enhanced Learning from Professors' Experiences in Emergency Remote Teaching. *Frontiers in Education*, 8, 1250461. <https://doi.org/10.3389/feduc.2023.1250461>
- Fullan, M., & Langworthy, M. (2014). *A Rich Seam: How New Pedagogies Find Deep Learning* [Monograph]. Pearson. https://www.michaelfullan.ca/wp-content/uploads/2014/01/3897.Rich_Seam_web.pdf
- Gechere, T., Oumer, J., & Ouke, T. (2025). Influence of Principals' Instructional Leadership and Teachers' Efficacy on Students' Performance in Secondary Schools in the Wolaita Zone, South Ethiopia. *Discover Sustainability*, 6(1), 967. <https://doi.org/10.1007/s43621-025-01797-3>
- Ghavifekr, S., & Wong, S. Y. (2021). Technology Leadership in Malaysian Schools: The Way Forward to Education 4.0 – ICT Utilization and Digital Transformation. *International Journal of Asian Business and Information Management*, 13(2), 1–18. <https://doi.org/10.4018/IJABIM.20220701.oa3>
- Goddard, Y. L., Goddard, R. D., Bailes, L. P., & Nichols, R. (2019). From School Leadership to Differentiated Instruction: A Pathway to Student Learning in Schools. *The Elementary School Journal*, 120(2), 197–219. <https://doi.org/10.1086/705827>
- Gümüş, S., Çağatay Kılınç, A., & Bellibaş, M. S. (2022). The Relationship Between Teacher Leadership Capacity at School and Teacher Self-efficacy: The Mediating Role of Teacher Professional Learning. *School Leadership & Management*, 42(5), 478–497. <https://doi.org/10.1080/13632434.2022.2123791>
- Kalyani, L. K. (2024). The Role of Technology in Education: Enhancing Learning Outcomes and 21st Century Skills. *International Journal of Scientific Research in Modern Science and Technology*, 3(4), 05–10. <https://doi.org/10.59828/ijrmst.v3i4.199>
- Kim, J. (2024). Leading Teachers' Perspective on Teacher-AI Collaboration in Education. *Education and Information Technologies*, 29(7), 8693–8724. <https://doi.org/10.1007/s10639-023-12109-5>
- Koo, S., Chiu, H., & Busse, R. T. (2022). The Effects of a Holistic College Access Camp on First-Gen Students: A Small Group Program Evaluation Using the Reliable Change Index. *Journal of First-Generation Student Success*, 2(3), 179–194. <https://doi.org/10.1080/26906015.2022.2086772>
- Labotan, M. S. (2026). School Heads' Digital-Pedagogical Leadership and Teachers' Digital Practices: Implications for Learners' Strategic Learning Behaviors in La Trinidad, Benguet, Philippines. *Journal of ICT and Education*, 1(2), 1–21. <https://doi.org/10.69739/jicte.v1i2.1832>
- Liebowitz, D. D., & Porter, L. (2019). The Effect of Principal Behaviors on Student, Teacher, and School Outcomes: A Systematic Review and Meta-Analysis of the Empirical Literature. *Review of Educational Research*, 89(5), 785–827. <https://doi.org/10.3102/0034654319866133>
- Lin, L., & Wang, C. (2025). The Impact of University Teachers' Transformational Leadership on Students' Social-emotional Competence: The Mediating Role of Teacher-student Relationship and Learning Engagement with Moderated by Self-efficacy. *Frontiers in Psychology*, 16, 1657492. <https://doi.org/10.3389/fpsyg.2025.1657492>
- Liu, S., & Feng, D. (2023). How Rural Principals Motivate Teacher Professional Learning in

- Unfavorable Environments: A Mixed-methods Study in China. In P. A. Woods, A. Roberts, M. Tian, & H. Youngs (Eds.), *Handbook on Leadership in Education* (pp. 359–374). Edward Elgar Publishing. <https://doi.org/10.4337/9781800880429.00033>
- Nardi, P. M. (2018). *Doing Survey Research: A Guide to Quantitative Methods* (Fourth edition). Routledge, Taylor & Francis Group. <https://doi.org/10.4324/9781315172231>
- Paramansyah, A. (2026). Digital Leadership Strategies of School Principals in Addressing Educational Technology Disruption. *Oikonomia: Journal of Management Economics and Accounting*, 3(3), 20–30. <https://doi.org/10.61942/oikonomia.v3i3.576>
- Qi, S., & Derakhshan, A. (2025). Technology-based Collaborative Learning: EFL learners' Social Regulation and Modifications in Their Academic Emotions and Academic Performance. *Education and Information Technologies*, 30(7), 8611–8636. <https://doi.org/10.1007/s10639-024-13167-z>
- Renz, A., & Vladova, G. (2021). Reinvigorating the Discourse on Human-Centered Artificial Intelligence in Educational Technologies. *Technology Innovation Management Review*, 11(5), 5–16. <https://doi.org/10.22215/timreview/1438>
- Riddel, M., & Zufikar, I. R. (2024). The Role of Innovative Leadership in Transforming Student Learning Effectiveness: A Review of Best Practices and Future Directions. *Development: Studies in Educational Management and Leadership*, 3(1), 35–50. <https://doi.org/10.47766/development.v3i1.1913>
- Secuya, A. G., & Obiso, D. (2026). Instructional Supervision and Student Learning Engagement: A Mixed Methods Correlational Study. *Psychology and Education: A Multidisciplinary Journal*, 62(3), 366–386. <https://doi.org/10.70838/pemj.620308>
- Seo, K., Tang, J., Roll, I., Fels, S., & Yoon, D. (2021). The Impact of Artificial Intelligence on Learner–Instructor Interaction in Online Learning. *International Journal of Educational Technology in Higher Education*, 18(1), 54. <https://doi.org/10.1186/s41239-021-00292-9>
- Soliman. (2026). Digital Competence among EFL Teachers: A Review of Challenges and Developmental Needs. *Al-Farooq Journal of Sciences*, 22453–2433), 3 ملحق(. <https://doi.org/10.65405/psmk8j64>
- Sultana, I., & Sajjad, Prof. Dr. S. (2025). Shaping Young Minds: How School Environment Predicts Social and Emotional Learning (SEL) in Primary Schools. *Inverge Journal of Social Sciences*, 4(3), 143–155. <https://doi.org/10.63544/ijss.v4i3.154>
- Sunaryo, R., Suwignyo, A., Herdiyanto, S., & Nurkolis, N. (2026). Digital Leadership Transformation of School Principals in Enhancing Teachers' Professional Competence in Elementary Schools. *Attadrib: Jurnal Pendidikan Guru Madrasah Ibtidaiyah*, 9(1), 265–276. <https://doi.org/10.54069/attadrib.v9i1.1223>
- Tao, S., Lan, M., Wang, M., & Li, H. (2026). Potential Risks of Generative Artificial Intelligence Integration into K-12 Education: A Scoping Review. *Computers and Education: Artificial Intelligence*, 10, 100561. <https://doi.org/10.1016/j.caeai.2026.100561>
- Tariq, M. U. (2025). AI-Driven Personalized Learning: Revolutionizing Student Engagement and Teacher Efficiency in Education 5.0. In F. D. Mobo (Ed.), *Advances in Computational Intelligence and Robotics* (pp. 75–96). IGI Global Scientific Publishing. <https://doi.org/10.4018/979-8-3693-9770-1.ch004>
- Toding, R. W., Halim, A., Abduh, A., Mahmud, M., Halim, N. M., & Julianti, R. (2024). Utilizing the TPACK Framework in English Language Instruction for High School Students. *JEELS (Journal of English Education and Linguistics Studies)*, 11(2), 793–819. <https://doi.org/10.30762/jeels.v11i2.3638>
- Yeboah, A. K., Dadson, Y. A., Mohammed, Z., & Hussein, M. (2026). Challenges and Prospects of

- Integrating Generative AI in Constructivist Learning Environments in Higher Education: Perspectives of Faculty and Students. *Artificial Intelligence in Education*, 2(4), 38–63. <https://doi.org/10.1108/AIIE-07-2025-0184>
- Zhai, X., Chu, X., Chai, C. S., Jong, M. S. Y., Istenic, A., Spector, M., Liu, J.-B., Yuan, J., & Li, Y. (2021). A Review of Artificial Intelligence (AI) in Education from 2010 to 2020. *Complexity*, 2021(1), 8812542. <https://doi.org/10.1155/2021/8812542>
- Zhang, L., Huang, Y., Fang, L., Guan, T., Jong, M. S.-Y., & Shang, J. (2026). Game Design for Emotional Dynamics: The Role of Visual Color and Gameplay Activities in Shaping Emotional Transitions in Digital Game-Based Language Learning. *International Journal of Human–Computer Interaction*, 1–31. <https://doi.org/10.1080/10447318.2026.2630086>
- Zhou, J., Jin, L., & Hu, Y. (2026). From Distraction to Addiction? Understanding Academic Cyberslacking as A Behavioral Dependency among Medical Students. *Frontiers in Psychology*, 16, 1592370. <https://doi.org/10.3389/fpsyg.2025.1592370>
- Zimosz, P., & Ober, J. (2025). Impact of Artificial Intelligence on Education. *Knowledge Economy and Lifelong Learning*, 1(2), 77–98. [https://doi.org/10.61093/kell.1\(2\).77-98.2025](https://doi.org/10.61093/kell.1(2).77-98.2025)