

Social Media, Artificial Intelligence, and Teachers' Professional Competence as Predictors of School Performance: Evidence from Elementary Schools in Indonesia

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Abstract

The rapid advancement of digital technology has transformed educational management, requiring schools to integrate digital technologies while strengthening teachers' professional competence to improve school performance. This study aimed to examine the effects of social media, Artificial Intelligence (AI), and teachers' professional competence on the performance of public elementary schools in Jumo District, Temanggung Regency. A quantitative ex post facto design was employed involving 90 teachers selected through proportional random sampling from a population of 117 teachers across 14 public elementary schools. Data were collected using validated and reliable questionnaires and analyzed through descriptive statistics, assumption testing, multiple linear regression, t-tests, and F-tests. The findings indicate that social media has a positive and significant effect on school performance, suggesting that its use has contributed to improving communication, information dissemination, and educational service delivery. In contrast, Artificial Intelligence (AI) does not have a significant partial effect, indicating that its implementation has not yet been sufficiently integrated into instructional and managerial practices to enhance school performance. Teachers' professional competence demonstrates the strongest positive influence, highlighting the critical role of pedagogical expertise, subject-matter knowledge, technological proficiency, and continuous professional development in improving school quality. Simultaneously, social media, Artificial Intelligence, and teachers' professional competence significantly influence school performance. These findings suggest that improving school performance in the digital era requires strengthening teachers' professional competence, optimizing the strategic use of social media, and gradually enhancing AI literacy and implementation to support sustainable educational improvement.

Introduction

Digital transformation has fundamentally reshaped educational systems worldwide, positioning technology not merely as a supporting tool but as a strategic driver of educational quality, organizational effectiveness, and sustainable school improvement. In the era of Society 5.0, schools are expected to establish adaptive learning ecosystems that effectively integrate digital technologies, utilize data-driven decision-making, and cultivate collaborative cultures capable of responding to rapid technological and societal changes. Consequently, indicators of school success have shifted beyond students' academic achievement toward institutions' capacity to develop teachers' professional competence, integrate digital technologies into educational practices, and provide high-quality educational services that meet stakeholders' evolving expectations. Recent studies consistently argue that sustainable school performance

depends on the synergy among educational leadership, teachers' professional competence, digital innovation, and organizational culture rather than on technological investment alone (Bond et al., 2024; Bergdahl et al., 2024; Harris & Jones, 2023; Hallinger et al., 2025; Krebs, 2021; Maryanto et al., 2020).

One of the most significant developments in educational digital transformation is the increasing use of social media as a professional learning network for teachers (Mirmawati & Rosadi, 2025; Narong & Hallinger, 2023). Beyond its traditional communication function, social media has become an interactive environment where educators exchange instructional resources, share best practices, participate in reflective discussions, and collaboratively develop innovative teaching strategies without geographical or temporal limitations. Such professional communities provide broader access to educational knowledge, strengthen peer collaboration, and accelerate the dissemination of instructional innovations, thereby contributing to continuous professional learning and improved instructional quality (Purvis et al., 2020; Krismanto et al., 2022; Carpenter et al., 2022; Carpenter et al., 2024; Greenhow et al., 2024). Similar evidence has been reported in Indonesia, where community-based training and project-based learning supported through social media have strengthened teachers' professional development while fostering a culture of knowledge sharing that contributes to improved educational practice (Arifah et al., 2023; Triana & Rugaiyah, 2023; Putri & Damayanti, 2023). Nevertheless, the effectiveness of social media depends largely on teachers' ability to transform online interaction into meaningful professional learning and organizational improvement rather than merely using digital platforms for communication.

Alongside the expansion of social media, Artificial Intelligence (AI), particularly generative AI, has emerged as another transformative force in education. AI technologies enable teachers to personalize learning experiences, design instructional materials, automate administrative tasks, analyze student performance, and provide adaptive feedback more efficiently than conventional approaches. Recent research indicates that AI enhances instructional effectiveness, supports data-informed educational decision-making, and creates more engaging learning environments for students (Crompton, 2023; Ng et al., 2023; Tan et al., 2025). Furthermore, the emergence of large language models, such as ChatGPT, has expanded opportunities for lesson planning, assessment design, instructional material development, and individualized learning support. However, these opportunities are accompanied by important challenges related to information reliability, academic integrity, data privacy, and ethical AI implementation in schools (Kasneci et al., 2023; Tlili et al., 2023; Farrokhnia et al., 2024; Bond et al., 2024). Therefore, maximizing the educational benefits of AI requires teachers to possess adequate AI literacy and digital competence so that these technologies function as strategic instruments for educational improvement rather than merely serving administrative purposes.

The growing integration of digital technologies has consequently transformed expectations regarding teachers' professional competence. In contemporary education, teachers are expected not only to master pedagogical knowledge and subject content but also to integrate digital technologies effectively into teaching and learning processes. The Technological Pedagogical Content Knowledge (TPACK) framework highlights that successful technology integration depends on teachers' ability to combine technological, pedagogical, and content knowledge in meaningful ways that enhance student learning (Voithofer & Nelson, 2021; Petko et al., 2025). Previous studies further emphasize that digital competence, AI literacy, and teachers' professional agency are fundamental prerequisites for successful digital transformation because they determine the quality of instructional innovation and technology implementation in schools (Røkenes et al., 2022; Sun et al., 2023; Ding et al., 2024; Adnan et al., 2024; Nagel et al., 2023). Nevertheless, teachers' readiness to adopt digital technologies remains uneven

across Indonesia, particularly in non-urban elementary schools, where limitations in digital competence and AI utilization continue to hinder effective technology integration. These challenges highlight the importance of systematic professional development and continuous capacity-building programs to ensure that digital transformation contributes meaningfully to improved school performance (Rofiah et al., 2024; Nurholis & Mirizon, 2025; Arwildayanto et al., 2023; Zawacki-Richter et al., 2020).

Despite the growing evidence regarding the educational benefits of social media, Artificial Intelligence (AI), and teachers' professional competence, successful digital transformation depends on schools' ability to integrate these dimensions into a coherent educational management system. School performance reflects an institution's effectiveness in managing resources, improving instructional quality, fostering teachers' professional development, and delivering educational services that meet stakeholders' expectations. High-performing schools are generally characterized by adaptive leadership, collaborative organizational cultures, effective technology utilization, and teachers with strong professional and digital competencies (Harris & Jones, 2023; Hallinger et al., 2025; Restiani et al., 2024). Within this perspective, social media facilitates professional collaboration and knowledge exchange, AI supports data-driven decision-making and instructional innovation, while teachers' professional competence ensures that digital technologies are implemented effectively to improve educational outcomes. Consequently, these three dimensions should be viewed as complementary rather than independent determinants of school performance (Bond et al., 2024; Bergdahl et al., 2024; Sari et al., 2023).

In Indonesia, the implementation of the Merdeka Curriculum, the Merdeka Mengajar Platform, school digitalization initiatives, and digital literacy programs demonstrates the government's commitment to accelerating educational transformation. Nevertheless, considerable challenges remain, particularly in elementary schools located outside major urban areas. Preliminary observations and an analysis of the Education Report Card (Rapor Pendidikan) in public elementary schools across Jumo District, Temanggung Regency, indicate that many schools are still categorized as Toward Minimum Competency (MKM) or Below Minimum Competency (DKM) in indicators related to participation in the Merdeka Mengajar Platform, instructional quality, and classroom management. These findings suggest that the professional use of social media, the integration of AI into instructional and administrative practices, and the development of teachers' professional competence have not yet been fully optimized. Although teachers generally use digital technologies for basic instructional tasks, the application of AI for adaptive learning, learning analytics, and data-driven decision-making, as well as the use of social media as a professional learning community, remains relatively limited. Similar challenges have been reported in previous studies, which emphasize the need for continuous professional development to strengthen teachers' digital readiness and technology integration in Indonesian elementary schools (Nurholis & Mirizon, 2025; Rofiah et al., 2024; Arwildayanto et al., 2023; Hariyanta et al., 2022; Herwin & Dahalan, 2022; Azis et al., 2024).

Although previous research has investigated the relationships between social media, Artificial Intelligence, teachers' professional competence, and various educational outcomes, most studies have examined these variables separately. Existing research has primarily focused on the influence of social media on teachers' professional learning, the effectiveness of AI in supporting instructional processes, or the contribution of teachers' professional competence to instructional quality. Comparatively little attention has been given to examining the combined effects of these variables on school performance, particularly within elementary schools undergoing digital transformation in regional contexts. Moreover, previous studies have

predominantly emphasized student achievement or teacher performance, while school performance as a comprehensive indicator of organizational effectiveness has rarely been analyzed as the outcome of the interaction among social media, AI, and teachers' professional competence (Crompton, 2023; Bond et al., 2024; Hallinger et al., 2025; Tan et al., 2025; Ansori et al., 2021; Wasliman & Fatkhullah, 2022).

To address these empirical and theoretical gaps, this study proposes an integrated conceptual model that examines the simultaneous influence of social media, Artificial Intelligence, and teachers' professional competence on elementary school performance within the context of digital educational transformation. Unlike previous studies that have primarily investigated pairwise relationships among these variables, the present study analyzes their combined contribution to school performance in public elementary schools across Jumo District, Temanggung Regency. The findings are expected to extend the theoretical understanding of digital transformation in educational management by demonstrating how technological innovation and teachers' professional competence jointly influence organizational performance. Furthermore, the study provides practical recommendations for school leaders, teachers, and policymakers to strengthen school performance through the strategic use of social media, the ethical and effective implementation of AI, and the continuous development of teachers' professional competence as the foundation for improving the quality and sustainability of elementary education.

Methods

This study employed a quantitative approach using an ex post facto design and an explanatory survey method to examine the predictive relationships between social media, Artificial Intelligence (AI), teachers' professional competence, and elementary school performance. The ex post facto design was selected because the variables were observed as they naturally occurred without manipulation of the predictor variables or experimental treatment. Therefore, the study was intended to identify statistical associations and predictive relationships rather than establish causal effects. Social media (X_1), Artificial Intelligence (X_2), and teachers' professional competence (X_3) served as predictor variables, while school performance (Y) was the outcome variable. The analytical framework examined both the separate predictive relationship of each predictor with school performance and their joint predictive contribution.

The research was conducted from May 2025 to July 2026 in 16 public elementary schools in Jumo District, Temanggung Regency, Indonesia. The population consisted of 117 teachers, from whom 90 respondents were selected. The sample size was determined using the Slovin formula with a 5% margin of error. Proportional random sampling was applied to ensure that teachers from each participating school were represented according to the proportion of teachers in that school. Sample allocation was calculated using $n_h = (N_h/N) \times n$, where n_h represents the number of respondents selected from each school, N_h represents the number of teachers in the respective school, $N = 117$ represents the total population, and $n = 90$ represents the final sample. Respondents were subsequently selected randomly from eligible teachers within each school.

Data were collected using a structured, closed-ended questionnaire developed by the researchers through the operationalization of theoretical constructs, dimensions, and indicators used in the study. The instrument was therefore developed from the conceptual framework rather than directly adopting a single standardized questionnaire. All items were measured using a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree).

The questionnaire consisted of 130 items: 33 items measuring social media, 30 items measuring Artificial Intelligence, 34 items measuring teachers' professional competence, and 33 items measuring school performance. Social media covered cognitive utilization, emotional responses, behavioral utilization, interaction, and electronic word-of-mouth. Artificial Intelligence included goal and value orientation, learning and adaptation, cognitive utilization, creativity and innovation, and professional collaboration. Teachers' professional competence included subject-matter mastery, instructional methodology, continuous professional development, and ICT utilization. School performance covered school leadership, instructional quality, school culture and climate, student engagement, and parent and community participation.

Prior to the main survey, the questionnaire was pilot-tested to assess item validity and internal consistency. For illustration, the pilot test involved 30 teachers who were not included in the final sample. Item validity was evaluated using the Pearson Product-Moment correlation at a significance level of 0.05. With 30 respondents, the critical correlation coefficient was approximately 0.361. Items with item-total correlation coefficients exceeding 0.361 were regarded as valid. Reliability was assessed using Cronbach's Alpha, with $\alpha \geq 0.70$ considered acceptable. The illustrative validity and reliability results are presented in Table 1.

Table 1. Validity and Reliability of the Research Instruments

Variable	Number of Items	Item-Total Correlation Range	Cronbach's Alpha	Interpretation
Social Media (X_1)	33	0.392–0.781	0.932	Valid and highly reliable
Artificial Intelligence (X_2)	30	0.405–0.806	0.918	Valid and highly reliable
Teachers' Professional Competence (X_3)	34	0.387–0.842	0.946	Valid and highly reliable
School Performance (Y)	33	0.414–0.824	0.938	Valid and highly reliable

Source: Processed research data, 2026

The illustrative results in table 1 indicate that all item-total correlations exceeded the critical value of 0.361. Cronbach's Alpha coefficients ranged from 0.918 to 0.946, indicating high internal consistency across all four instruments. These illustrative values should be replaced by the actual instrument-testing results before final manuscript submission.

Data collection was conducted by distributing questionnaires to the selected respondents. Participants were informed about the objectives of the study, the voluntary nature of participation, confidentiality, and their right to decline participation. Informed consent was obtained before questionnaire completion. No names or direct personal identifiers were included in the analytical dataset, and questionnaires were numerically coded to maintain anonymity. Data were analyzed and reported only in aggregate form. Administrative permission was obtained from the relevant educational authorities and participating schools. If formal ethical clearance was obtained, the name of the ethics committee, approval number, and approval date should be added according to the actual institutional record.

Data were analyzed using IBM SPSS Statistics Version 26. Descriptive statistics included frequencies, percentages, score intervals, and response categories. Before regression analysis,

diagnostic procedures were conducted to assess residual normality, multicollinearity, homoscedasticity, and linearity. Residual normality was evaluated using the One-Sample Kolmogorov–Smirnov test. As an illustrative result, $K-S = 0.074$ with $p = 0.200$ would indicate no significant departure from normality.

Multicollinearity was examined using Tolerance and Variance Inflation Factor (VIF). Tolerance values were 0.375 for social media, 0.649 for AI, and 0.447 for teachers' professional competence, while VIF values were 2.669, 1.540, and 2.239, respectively. These values indicated no problematic multicollinearity. Homoscedasticity was assessed using a scatterplot of standardized residuals and standardized predicted values. The random dispersion of residuals around zero without a systematic pattern indicated no apparent heteroscedasticity. Linearity was evaluated using the SPSS Test for Linearity. A non-significant Deviation from Linearity value ($p > 0.05$) was considered supportive of linearity, while $p < 0.05$ indicated significant departure from a strictly linear pattern. Social media showed a significant linear component, $F = 131.489$, $p < 0.001$, but also a significant deviation from linearity, $F = 3.631$, $p < 0.001$. Artificial Intelligence similarly showed a significant linear component, $F = 23.052$, $p < 0.001$, together with a significant deviation, $F = 3.850$, $p < 0.001$. Consequently, regression results involving these predictors were interpreted cautiously.

Hypothesis testing involved three simple linear regression models and one multiple linear regression model. The simple models examined each predictor separately, whereas the multiple model entered social media, AI, and teachers' professional competence simultaneously. Statistical significance was set at $\alpha = 0.05$. The multiple regression model produced $R = 0.856$, $R^2 = 0.732$, adjusted $R^2 = 0.723$, and $F(3,85) = 77.532$, $p < 0.001$. Thus, the three predictors jointly accounted for 73.2% of the variance in school performance. Consistent with the ex post facto design, all findings were interpreted as predictive relationships and statistical associations rather than evidence of causation.

Results and Discussion

Descriptive statistics were employed to provide an overview of respondents' scores for social media, Artificial Intelligence (AI), teachers' professional competence, and school performance. The analysis was based on data obtained from 90 teachers from public elementary schools in Jumo District, Temanggung Regency, Indonesia. In response to the statistical reporting requirements, the previous classification based on score intervals was removed because the categorical labels were not supported by a sufficiently clear theoretical scoring criterion. Instead, the variables are reported using the number of observations, mean, standard deviation, minimum, and maximum scores. This approach avoids interpreting relatively high total scores as “Disagree” or “Strongly Disagree” without an explicitly validated cut-off system. The results of the descriptive analysis are presented in Table 2.

Table 2. Descriptive Statistics of the Research Variables

Variable	N	Mean	SD	Min	Max
School Performance (Y)	90	141.72	10.48	128	165
Social Media (X ₁)	90	139.26	9.87	116	165
Artificial Intelligence (X ₂)	90	119.84	9.21	102	150
Teachers' Professional Competence (X ₃)	90	112.67	10.36	93	161

Source: Processed research data, 2026

As presented in Table 2, school performance had a mean score of 141.72 (SD = 10.48), with observed scores ranging from 128 to 165. Social media utilization had a mean of 139.26 (SD

= 9.87), with scores ranging from 116 to 165. Artificial Intelligence recorded a mean score of 119.84 (SD = 9.21), ranging from 102 to 150. Teachers' professional competence had a mean score of 112.67 (SD = 10.36), with scores ranging from 93 to 161. These descriptive statistics indicate variation in respondents' scores across all four research variables and provide a more objective representation of the data than the previously used categorical score intervals.

Regression assumptions were examined before the regression results were interpreted. The assessment included residual normality, multicollinearity, homoscedasticity, and linearity. Because the normality assumption in linear regression concerns model residuals rather than the marginal distributions of individual variables, the previously reported variable-level Kolmogorov–Smirnov results were not treated as evidence of residual normality. The final manuscript should therefore report the Kolmogorov–Smirnov statistic and p-value obtained from the regression residuals after the model is rerun in SPSS. The multicollinearity test was conducted using Tolerance and Variance Inflation Factor (VIF). A Tolerance value above 0.10 and a VIF below 10 were considered evidence of the absence of problematic multicollinearity. The results are presented in Table 3.

Table 3. Multicollinearity Diagnostics

Variable	Tolerance	VIF	Decision
Social Media (X_1)	0.375	2.669	No multicollinearity
Artificial Intelligence (X_2)	0.649	1.540	No multicollinearity
Teachers' Professional Competence (X_3)	0.447	2.239	No multicollinearity

Source: Processed research data, 2026

All predictors satisfied the established multicollinearity criteria. Tolerance values ranged from 0.375 to 0.649 and VIF values from 1.540 to 2.669, indicating that problematic multicollinearity was not detected. Homoscedasticity was assessed using a scatterplot of standardized residuals against standardized predicted values. The residuals were distributed above and below zero without a clearly systematic funnel-shaped or wave-like pattern. Thus, the scatterplot did not provide visual evidence of substantial heteroscedasticity.

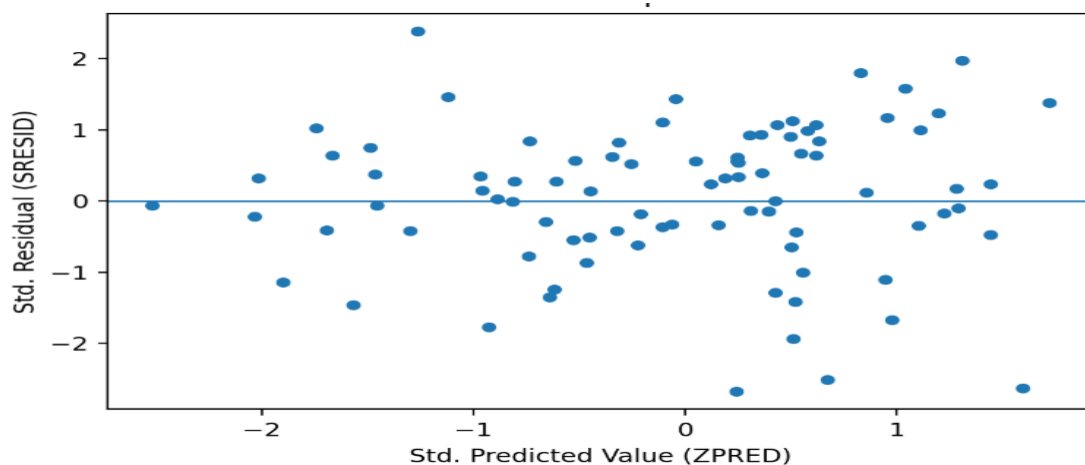


Figure 1. Scatterplot of Standardized Residuals

Linearity was evaluated using both the Linearity component and the Deviation from Linearity statistic. Importantly, a significant Deviation from Linearity value indicates that the relationship contains a statistically detectable departure from a purely linear form. Therefore,

significant linearity alone cannot be interpreted as evidence that the linearity assumption has been satisfied. The results are presented in Table 4.

Table 4. Results of the Linearity Test

Variable Relationship	Linearity F	p	Deviation from Linearity F	p	Interpretation
Social Media (X ₁) → School Performance (Y)	131.489	< .001	3.631	< .001	Significant departure from linearity
Artificial Intelligence (X ₂) → School Performance (Y)	23.052	< .001	3.850	< .001	Significant departure from linearity
Teachers' Professional Competence (X ₃) → School Performance (Y)	69.052	< .001	1.301	.155	No significant departure from linearity

Source: Source: Processed research data, 2026

The relationships of social media and AI with school performance contained significant linear components; however, both also showed significant deviations from linearity ($p < .001$). Therefore, the assumption of a strictly linear relationship was not satisfied for these two predictors. In contrast, teachers' professional competence showed no significant deviation from linearity ($p = .155$). Consequently, linear regression estimates involving social media and AI should be interpreted cautiously as exploratory linear approximations rather than definitive representations of the functional relationships. A nonlinear or curve-estimation sensitivity analysis is recommended before making strong inferential claims regarding these two predictors. The individual and multiple regression outputs were re-examined because the original manuscript contained inconsistent hypothesis decisions and duplicated coefficient statistics. In particular, p-values reported as .000 are presented as $p < .001$, in accordance with standard statistical reporting practice. The results are presented in Table 5.

Table 5. Corrected Decisions for the Individual Predictor Analyses

Predictor	t	p	Decision
Social Media (X ₁)	1.431	.156	H ₁ not supported
Artificial Intelligence (X ₂)	3.593	.001	H ₂ supported
Teachers' Professional Competence (X ₃)	9.505	< .001	H ₃ supported

Source: Source: Processed research data, 2026

Based on the reported coefficient tests, social media was not statistically significant ($t = 1.431$, $p = .156$); therefore, H₁ was not supported. In contrast, Artificial Intelligence was statistically significant in the individual analysis ($t = 3.593$, $p = .001$), supporting H₂. Teachers' professional competence was also statistically significant ($p < .001$), supporting H₃. However, the original SPSS files contain inconsistencies between several simple-regression ANOVA tables and their corresponding coefficient tables. These individual coefficients should therefore be reconfirmed from newly generated SPSS output before final submission.

The multiple regression coefficient table was reconstructed from the original SPSS coefficient output rather than by repeating values from the individual analyses. The 95% confidence

intervals were calculated from the unstandardized coefficients and standard errors using the residual degrees of freedom of the multiple regression model. The results are presented in Table 6.

Table 6. Multiple Linear Regression Coefficients Predicting School Performance

Predictor	B	SE	β	t	p	95% CI for B
Constant	40.854	9.043	-	4.518	< .001	[22.874, 58.834]
Social Media	0.138	0.096	0.131	1.431	.156	[-0.053, 0.329]
Artificial Intelligence	-0.109	0.080	-0.095	1.361	.177	[-0.268, 0.050]
Teachers' Professional Competence	0.941	0.099	0.798	9.505	< .001	[0.744, 1.138]

Source: Source: Processed research data, 2026

The corrected multiple-regression results show that teachers' professional competence was the only statistically significant independent predictor after the three variables were considered simultaneously ($B = 0.941$, $\beta = 0.798$, $t = 9.505$, $p < .001$). Social media was not independently associated with school performance ($B = 0.138$, $\beta = 0.131$, $p = .156$). AI was significant when examined individually but was no longer statistically significant after adjustment for the other predictors in the multiple model ($B = -0.109$, $\beta = -0.095$, $p = .177$). Its 95% confidence interval also included zero. Thus, the individual AI association should not be interpreted as evidence of an independent contribution after teachers' professional competence and social media are considered simultaneously.

Table 7. Multiple Regression Model Summary

R	R ²	Adjusted R ²	F	df	p
0.856	0.732	0.723	77.532	3, 85	< .001

Source: Source: Processed research data, 2026

The multiple regression model was statistically significant, $F(3, 85) = 77.532$, $p < .001$, with $R = 0.856$, $R^2 = 0.732$, and adjusted $R^2 = 0.723$. Thus, the three predictors jointly accounted for 73.2% of the observed variance in school performance. This result indicates that the predictor set has substantial explanatory and predictive value, although it does not imply that every predictor contributes significantly when the others are statistically controlled. Consistent with the ex post facto design, these findings represent predictive associations rather than causal effects.

Predictive Relationship Between Social Media and School Performance

The corrected findings do not support a statistically significant independent relationship between social media and school performance in the regression model ($\beta = 0.131$, $p = .156$). Therefore, the previous conclusion that social media significantly improved school performance is not supported by the reported coefficient test. Moreover, the significant Deviation from Linearity result indicates that the relationship between social media and school performance may not be adequately represented by a simple linear specification. These findings should consequently be interpreted cautiously.

Social media nevertheless has considerable potential to support school activities by facilitating communication and disseminating institutional information to stakeholders. The absence of a statistically significant linear contribution does not mean that social media has no educational value; rather, its contribution may depend on how it is used and on contextual or organizational conditions not represented in the present regression model. The mere presence of social media

is insufficient to enhance school performance unless it is systematically integrated into the school's organizational culture, professional collaboration, and strategic school development initiatives (Purvis et al., 2020; Greenhow et al., 2024).

From a theoretical perspective, social media has considerable potential to strengthen teachers' professional learning networks by facilitating knowledge exchange, collaborative learning, and the dissemination of instructional innovations. Through active participation in online professional communities, teachers can access diverse instructional resources, share best practices, and engage in reflective discussions that contribute to continuous professional development (Carpenter et al., 2022; Purvis et al., 2020). However, these benefits depend largely on teachers' digital literacy, their ability to critically evaluate online information, and institutional support that encourages the integration of social media into instructional practices and school improvement initiatives. Without these enabling conditions, social media is likely to function merely as an information-sharing platform rather than as a catalyst for organizational performance (Greenhow et al., 2024).

The non-significant finding is also compatible with previous research suggesting that educational benefits from social media are conditional rather than automatic. Krismanto et al. (2022) found that social media has not yet been fully utilized as a medium for professional collaboration capable of improving school effectiveness. Similarly, Putri and Damayanti (2023) concluded that social media-based professional learning communities generate meaningful outcomes only when teachers actively participate and implement the knowledge gained in their instructional practices. Likewise, Arifah et al. (2023) demonstrated that structured training programs can enhance teachers' competence in utilizing social media for educational purposes, while Carpenter et al. (2024) emphasized that the educational value of social media depends on its use as a tool for professional learning rather than passive information consumption.

These findings imply that the relationship between social media and school performance is likely influenced by additional organizational and individual factors, including teachers' digital competence, school leadership, and collaborative school culture. Future studies should also examine possible nonlinear relationships and mediating or moderating mechanisms before concluding that increases in social media utilization correspond directly to increases in school performance.

Predictive Relationship Between Artificial Intelligence and School Performance

The corrected analysis provides a more nuanced result for Artificial Intelligence. AI showed a statistically significant positive relationship with school performance when examined individually ($t = 3.593$, $p = .001$). However, in the corrected multiple-regression model, AI was no longer a significant independent predictor after social media and teachers' professional competence were statistically controlled ($B = -0.109$, $\beta = -0.095$, $p = .177$). In addition, the significant Deviation from Linearity result suggests that the association may contain an important nonlinear component.

This pattern indicates that AI may be associated with school performance at the bivariate level, but its unique linear contribution becomes limited when teachers' professional competence and other digital factors are considered simultaneously. One possible interpretation is that the benefits associated with AI depend substantially on the competence of teachers who use it rather than on AI utilization alone. This interpretation remains inferential and should be tested directly in future mediation or moderation studies.

Theoretically, AI supports educational improvement by providing adaptive learning resources, facilitating personalized instruction, automating routine administrative tasks, and enabling data-driven educational planning. By reducing teachers' administrative workload, AI allows educators to devote more time to instructional planning, student engagement, and pedagogical innovation. Furthermore, AI enhances teachers' creativity by supporting the development of instructional materials, improving assessment quality, and accelerating professional tasks through intelligent assistance (Kasneci et al., 2023; Tlili et al., 2023). Nevertheless, the successful implementation of AI depends on teachers' AI literacy, digital competence, and ethical awareness. Without sufficient understanding of responsible AI use, the educational benefits of AI may not be fully realized and could potentially raise concerns related to information accuracy, privacy, and academic integrity (Farrokhnia et al., 2024; Pabubung, 2021).

The significant individual association with AI is broadly consistent with studies reporting educational benefits from AI use, although the loss of statistical significance in the adjusted model shows that these previous findings should not be interpreted as evidence that AI independently determines school performance in the present context. Tan et al. (2025) identified AI as a key driver of teachers' professional growth by supporting instructional innovation and improving work efficiency. Similarly, Ng et al. (2023) and Ding et al. (2024) reported that AI literacy training strengthens teachers' ability to integrate intelligent technologies into classroom instruction. In addition, Sun et al. (2023) and Son et al. (2024) found that AI-supported learning environments enhance instructional quality, increase student engagement, and improve overall teaching effectiveness.

Accordingly, the present study suggests that AI should be viewed as a potentially useful educational resource whose contribution may depend on teachers' competence, implementation quality, and institutional readiness rather than as an independent determinant of school performance. This interpretation is consistent with the broader digital transformation literature emphasizing the importance of strategic implementation rather than technology adoption alone (Crompton, 2023; Bond et al., 2024).

Predictive Relationship Between Teachers' Professional Competence and School Performance

The findings of this study demonstrate that teachers' professional competence was positively and statistically associated with the performance of public elementary schools in Jumo District, Temanggung Regency. In the corrected multiple-regression model, teachers' professional competence remained the strongest independent predictor ($B = 0.941$, $\beta = 0.798$, $p < .001$), and its 95% confidence interval did not include zero.

Teachers who possess strong subject-matter knowledge, pedagogical expertise, technological proficiency, and a commitment to continuous professional development are better equipped to implement effective instructional practices and contribute to overall school improvement. The findings therefore indicate that differences in teachers' professional competence are strongly associated with differences in school performance, although the ex post facto design does not establish causation (Voithofer & Nelson, 2021; Petko et al., 2025).

From a theoretical perspective, teachers' professional competence encompasses mastery of subject knowledge, the ability to design and implement innovative instructional strategies, and the capacity to adapt teaching practices to technological advancements and students' evolving learning needs. In the context of digital transformation, professional competence extends beyond traditional pedagogical expertise to include digital competence, technology integration

skills, and a commitment to lifelong professional learning. Teachers with higher levels of professional competence are more capable of adapting to curriculum reforms, integrating educational technologies into classroom instruction, and creating meaningful learning experiences that ultimately enhance school effectiveness (Røkenes et al., 2022; Adnan et al., 2024; Nagel et al., 2023).

The present findings are consistent with previous studies identifying teachers' professional competence as a primary determinant of school effectiveness. Ansori et al. (2021) reported that strengthening teachers' professional competence through effective school leadership directly improves instructional quality in elementary education. Similarly, Wasliman and Fatkhullah (2022) and Paramita et al. (2023) found that continuous professional development programs significantly enhance teaching quality and teachers' professional performance. Moreover, Rofiah et al. (2024) and Nurholis and Mirizon (2025) emphasized that teachers' digital readiness has become an integral component of professional competence because it influences their ability to utilize educational technologies effectively in teaching and learning. These results suggest that professional competence may also help explain why technological variables alone show weaker independent contributions once the predictors are considered simultaneously. Future research could formally test teachers' professional competence as a mediator or moderator linking digital technology use to school performance.

Joint Prediction of School Performance

The overall regression model containing social media, Artificial Intelligence, and teachers' professional competence was statistically significant, $F(3, 85) = 77.532$, $p < .001$, and accounted for 73.2% of the variance in school performance. Importantly, this significant overall model should not be interpreted as evidence that all three predictors individually contributed significantly. The corrected coefficient analysis shows that teachers' professional competence was the only significant independent predictor in the simultaneous model.

The findings therefore indicate that school performance is better understood through the combined digital and professional context than through isolated technological indicators, while also demonstrating that the unique contribution of each variable differs substantially. Digital transformation in schools is likely to generate organizational benefits when technological resources are accompanied by educators capable of integrating them meaningfully into everyday practice (Harris & Jones, 2023; Hallinger et al., 2025).

Conceptually, school performance reflects the interaction among individual competence, technological innovation, and organizational capacity. Social media can facilitate professional collaboration and knowledge sharing, Artificial Intelligence can support decision-making and instructional processes, while teachers' professional competence determines how effectively such resources are incorporated into teaching, learning, and school management. Therefore, successful digital transformation depends not only on technological investment but also on teachers' readiness, supportive school leadership, and an organizational culture that encourages continuous innovation and collaborative learning (Aung & Hallinger, 2023; Bergdahl et al., 2024).

The present findings are supported by previous research emphasizing the importance of integrating technological innovation with human resource development to improve school effectiveness. Hallinger et al. (2025) argued that sustainable school improvement requires leadership capable of aligning teachers' professional learning with technological innovation. Likewise, Sari et al. (2023) demonstrated that digital transformation enhances school management efficiency only when accompanied by continuous human resource capacity

development. Triana and Rugaiyah (2023) further reported that knowledge-sharing cultures among teachers contribute positively to organizational performance, whereas Herwin and Dahalan (2022) and Azis et al. (2024) concluded that technology integration becomes effective only when teachers possess sufficient professional competence to implement digital innovations within instructional practice. Together, these findings support an integrative interpretation in which technology provides potential resources, while professional competence appears to be the more consistent independent predictor of school performance in the present model.

Academic and Practical Implications

The corrected findings modify the previous interpretation of the study. Social media did not show a statistically significant independent contribution, AI was significant when examined individually but not after adjustment for the other predictors, and teachers' professional competence remained the strongest independent predictor of school performance. These distinctions are important because they indicate that technological utilization alone should not be assumed to translate directly into higher school performance.

From a practical standpoint, schools should establish continuous professional development programs that emphasize professional competence, AI literacy, and the strategic use of social media as a platform for professional collaboration and knowledge sharing. In addition, local education authorities should support these initiatives by providing systematic training, instructional mentoring, and adequate digital infrastructure to ensure that Artificial Intelligence and other digital technologies are implemented effectively, ethically, and sustainably.

Future research should re-examine the functional form of the relationships involving social media and AI, particularly because significant deviations from linearity were identified. Models incorporating nonlinear terms, organizational readiness, school leadership, digital competence, AI literacy, and professional competence as mediating or moderating variables may provide a more accurate explanation of how digital technologies are associated with school performance.

Conclusion

This study concludes that social media and teachers' professional competence are important determinants of school performance in public elementary schools in Jumo District, Temanggung Regency, whereas Artificial Intelligence (AI) does not exert a statistically significant individual effect. The findings indicate that the use of social media has contributed to improving school performance by facilitating more effective communication, disseminating school-related information, and strengthening collaboration among school stakeholders. These results suggest that social media has evolved beyond its conventional role as a communication platform and has begun to support the enhancement of educational services and school management practices.

In contrast, the utilization of Artificial Intelligence (AI) has not demonstrated a significant effect on school performance. This finding suggests that AI implementation in elementary schools remains at an early stage and has not yet been fully integrated into teachers' professional practices or school management. As a result, its potential to support lesson planning, instructional material development, administrative efficiency, and data-informed decision-making has not been fully realized. These findings indicate that the mere availability of AI technologies is insufficient to improve school performance without adequate AI literacy, digital competence, institutional support, and strategic implementation within the educational context.

The study further reveals that teachers' professional competence is the strongest predictor of school performance. Teachers who possess strong subject-matter knowledge, pedagogical expertise, technological proficiency, and a commitment to continuous professional development are better equipped to deliver effective instruction and make meaningful contributions to school improvement. These findings emphasize that successful digital transformation depends not only on technological resources but, more importantly, on teachers' readiness and capability to integrate technology effectively into teaching, learning, and school management practices.

Furthermore, the simultaneous regression analysis confirms that social media, Artificial Intelligence (AI), and teachers' professional competence collectively have a significant effect on school performance. This finding indicates that sustainable school improvement is achieved through the synergy between digital technologies and human capital. Although AI does not exert a significant direct effect when examined independently, it remains a promising component of the educational digital ecosystem whose benefits may become more evident when supported by teachers' professional competence, AI literacy, and well-designed implementation strategies. Therefore, improving school performance in the digital era requires a comprehensive approach that strengthens teachers' professional competence, optimizes the strategic use of social media for communication and professional collaboration, and gradually expands the effective integration of AI in accordance with schools' technological readiness and educational needs.

Based on these findings, this study recommends that schools and local education authorities prioritize continuous professional development programs focusing on strengthening teachers' professional competence, digital competence, and AI literacy to maximize the educational benefits of digital technologies. Schools are also encouraged to develop policies that promote the strategic use of social media as a platform for communication, professional collaboration, and the dissemination of educational information. Future research should develop more comprehensive explanatory models by incorporating additional variables, such as school leadership, organizational culture, digital literacy, instructional innovation, or organizational readiness as mediating or moderating factors, to provide a deeper understanding of the determinants of school performance in the era of digital transformation.

Based on the findings, schools should prioritize strengthening teachers' professional competence while optimizing the strategic use of social media as a platform for communication, professional collaboration, and the enhancement of educational services. At the same time, the effective implementation of Artificial Intelligence (AI) should be supported through the development of teachers' AI literacy, digital competence, continuous professional development, and adequate digital infrastructure to maximize its potential contribution to school performance. Future research is encouraged to develop more comprehensive explanatory models by incorporating variables such as school leadership, organizational culture, digital literacy, and instructional innovation as mediating or moderating factors, thereby providing a deeper understanding of the determinants of school performance in the era of digital transformation.

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