



The Influence of Supervisors' Performance and Madrasah Principals' Leadership on The Quality of Inclusive Schools in the Era of Digital Transformation

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ABSTRACT

Purpose of the study: This study examines the influence of supervisors' performance and madrasah principals' leadership on the quality of inclusive schools in the era of digital transformation. Although educational supervision and school leadership are widely recognized as determinants of school quality, empirical evidence regarding their integrated contribution to strengthening inclusive educational management remains limited.

Methodology: This study employed a quantitative survey design involving all 16 teachers at Madrasah Aliyah Negeri in Bantaeng Regency, Indonesia, using a saturated sampling technique. Data were collected through a self-developed questionnaire that was validated by experts and demonstrated excellent reliability. Descriptive statistics, simple linear regression, and multiple linear regression analyses were conducted using IBM SPSS Statistics Version 25.

Main Findings: The findings indicate that supervisors' performance has a positive and significant influence on inclusive school quality, explaining 40.2% of the variance, while madrasah principals' leadership explains 78.4%. Simultaneously, both variables explain 81.9% of the variance, indicating that their combined contribution provides greater explanatory power than either variable individually. These findings demonstrate that collaborative educational leadership strengthens teacher professionalism, organizational innovation, and inclusive educational practices in the digital transformation era.

Novelty/Originality of this study: This study proposes the Collaborative Educationa' Leadership for Inclusive Madrasahs framework, integrating supervisors' performance and madrasah principals' leadership into a unified model for improving inclusive school quality. The findings provide practical implications for policymakers and educational stakeholders to strengthen instructional supervision, transformational and digital leadership, and collaborative governance through continuous professional development to support sustainable inclusive education.

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1. INTRODUCTION

The rapid advancement of digital technology has fundamentally transformed educational systems worldwide, requiring schools to become more adaptive, innovative, and inclusive in responding to increasingly complex educational demands [1]–[3]. Digital transformation extends beyond the adoption of technological infrastructure; it also requires improvements in educational governance, leadership, organizational management, and supervisory practices that collectively enhance school quality and educational equity [4], [5]. Consequently, educational institutions are expected to strengthen their organizational capacity to respond effectively to technological change while ensuring that all learners receive equitable, accessible, and high-quality educational services [6], [7]. For Islamic secondary schools (madrasahs), this transformation presents additional challenges because digital innovation must be integrated with Islamic educational values while maintaining academic excellence and inclusive educational practices [8]–[11]. Therefore, improving the quality of inclusive madrasahs has become a strategic priority for achieving sustainable educational development in the era of digital transformation.

Inclusive schools are expected to provide equitable learning opportunities for students with diverse academic, social, cultural, and individual characteristics without compromising educational quality [12], [13]. Achieving this objective requires not only adequate technological readiness but also effective educational leadership capable of directing institutional change, strengthening collaboration, supporting teachers' professional development, and promoting continuous school improvement [14]–[18]. Among the organizational factors influencing school quality, educational supervision and principals' leadership have consistently been recognized as two of the most important determinants of school effectiveness [19].

Educational supervisors contribute to school improvement through academic supervision, instructional monitoring, teacher mentoring, and continuous professional development [20]. Meanwhile, madrasah principals play a strategic role in establishing institutional vision, managing organizational resources, fostering teacher collaboration, promoting innovation, and ensuring the effective implementation of inclusive educational policies [21]. Previous studies have demonstrated that effective educational supervision enhances teachers' professional competence and instructional quality, whereas effective school leadership improves organizational performance, educational innovation, and overall school effectiveness [22]. Furthermore, recent studies indicate that digital transformation provides new opportunities to improve accessibility, participation, and learning support within inclusive education [23]–[27]. Collectively, these findings suggest that educational supervision and school leadership constitute essential organizational capacities for strengthening inclusive school quality.

Although previous studies have provided valuable insights into educational supervision and school leadership, several important research gaps remain. First, most previous studies have examined supervisors' performance and principals' leadership independently, providing fragmented explanations of the organizational factors influencing inclusive school quality [28]–[30]. Second, empirical studies investigating the combined influence of these two leadership dimensions remain limited, particularly in Indonesian madrasahs, whose governance systems, institutional characteristics, and religious values differ substantially from those of general schools [9], [31]–[33]. Consequently, current literature has not yet provided comprehensive empirical evidence explaining how supervisors' performance and principals' leadership jointly contribute to improving inclusive school quality in the era of digital transformation [34], [35].

Addressing these gaps is important because governments and educational institutions increasingly prioritize both digital transformation and inclusive education as strategic educational agendas. Without empirical evidence explaining the complementary roles of educational supervisors and madrasah principals, policies and school improvement programs may continue to treat supervision and leadership as separate organizational functions, thereby limiting their potential contribution to improving school quality. Therefore, this study simultaneously examines supervisors' performance and madrasah principals' leadership within a single analytical framework to explain their complementary contribution to strengthening inclusive school quality during digital transformation.

The novelty of this study lies in the development of the Collaborative Educational Leadership for Inclusive Madrasahs framework, which integrates supervisors' performance and madrasah principals' leadership into a unified organizational model for improving inclusive school quality. Unlike previous studies that examined these variables separately, this study empirically demonstrates their complementary influence on strengthening inclusive education in Islamic secondary schools undergoing digital transformation. The findings are expected to enrich the educational leadership literature while providing practical implications for policymakers and school administrators in strengthening instructional supervision, transformational leadership, collaborative governance, and continuous professional development to support sustainable inclusive education.

Accordingly, this study aims to: (1) examine the influence of supervisors' performance on the quality of inclusive schools; (2) analyze the influence of madrasah principals' leadership on the quality of inclusive schools; and (3) investigate the simultaneous influence of supervisors' performance and madrasah principals' leadership on the quality of inclusive schools in the era of digital transformation.

2. RESEARCH METHOD

This study employed a quantitative associative research [36], [37] design using a cross-sectional survey to examine the influence of supervisors' performance and madrasah principals' leadership on the quality of inclusive schools in the era of digital transformation. A quantitative approach was selected because it enables objective measurement of relationships among variables using statistical procedures, whereas an associative design is appropriate for examining the causal relationships between independent and dependent variables [14]. The cross-sectional survey design involved collecting data at a single point in time through a structured questionnaire administered to respondents.

The study was conducted at Madrasah Aliyah Negeri (MAN), Bantaeng Regency, Indonesia. The target population consisted of all teachers employed at the school, totaling 16 teachers. Considering that the population was relatively small and fully accessible, this study employed a saturated sampling (total sampling) technique, whereby all members of the population were included as research participants [36]. Consequently, the sample size was identical to the population size ($N = 16$).

The use of saturated sampling eliminates sampling bias because every member of the target population participates in the study [38], [39]. Therefore, the findings provide an accurate representation of the organizational conditions at MAN Bantaeng. Although the sample size is relatively limited, the purpose of the study is to explain the relationships among variables within the investigated population rather than to generalize findings to all madrasahs in Indonesia. Thus, the internal validity of the study is strengthened because no eligible respondents were excluded from the analysis. The demographic characteristics of the respondents are presented in Table 1.

Table 1. Characteristics of Research Respondents

Respondents	Frequency	Percentage (%)
Teachers	16	100.00
Total	16	100.00

As shown in Table 1, all respondents were teachers working at MAN, resulting in a homogeneous respondent profile. This composition is appropriate because teachers are directly involved in instructional activities, educational supervision, and school leadership implementation, enabling them to provide relevant information regarding supervisors' performance, principals' leadership, and inclusive school quality. Primary data were collected using a self-developed structured questionnaire designed by the researchers based on an extensive review of theories and previous empirical studies concerning educational supervision, school leadership, and inclusive school quality. The instrument was specifically developed to reflect the characteristics of Indonesian madrasahs and the objectives of this research.

To ensure content validity, the initial questionnaire was evaluated through expert judgment involving experts in educational management and educational evaluation. Following expert review, the instrument was revised and subsequently pilot-tested before being administered in the main study. The pilot test confirmed that all questionnaire items met the required validity criteria and were suitable for measuring the intended constructs. The questionnaire employed a five-point Likert scale, ranging from 1 (Strongly Disagree) to 5 (Strongly Agree). The instrument consisted of three research variables, each represented by five indicators and five measurement items.

Table 2. Instrument Grid

Variable	Indicators	Number of Items	Measurement Scale
Supervisors' Performance (X_1)	Academic supervision, teacher guidance, instructional monitoring, professional development, educational coordination	5	Five-point Likert Scale
Madrasah Principals' Leadership (X_2)	Visionary leadership, decision-making, teacher empowerment, school climate development, innovation management	5	Five-point Likert Scale
Inclusive School Quality (Y)	Accessibility, equity, participation, learning support, inclusive school environment	5	Five-point Likert Scale

Construct validity was assessed using the Pearson Product-Moment correlation. The results indicated that all questionnaire items exceeded the minimum acceptable correlation coefficient and were therefore declared valid. Instrument reliability was evaluated using Cronbach's Alpha, with a coefficient of 0.70 or above indicating acceptable internal consistency [40]. As shown in Table 3, all variables demonstrated Cronbach's Alpha coefficients above 0.90, indicating excellent reliability. The reliability results for each research variable are presented in Table 3.

Table 3. Reliability of Research Instrument

Variable	Cronbach's Alpha	Interpretation
Supervisors' Performance (X_1)	0.91	Excellent
Madrasah Principals' Leadership (X_2)	0.94	Excellent
Inclusive School Quality (Y)	0.90	Excellent

As presented in Table 3, all research variables achieved Cronbach's Alpha coefficients above 0.90, indicating excellent internal consistency. These results demonstrate that the research instrument is highly reliable and suitable for measuring supervisors' performance, madrasah principals' leadership, and inclusive school quality. Therefore, the questionnaire was considered appropriate for subsequent statistical analyses. Data collection was conducted through five sequential stages. First, the researchers identified the research variables and developed the questionnaire based on theoretical frameworks and previous empirical studies. Second, the instrument underwent expert validation and pilot testing to establish its validity and reliability. Third, the finalized questionnaire was distributed directly to all teachers at MAN Dampang. Fourth, completed questionnaires were coded, checked for completeness, and entered into IBM SPSS Statistics Version 25 for statistical analysis. Finally, the statistical findings were interpreted to answer the research questions and test the proposed hypotheses.

Data analysis was performed using IBM SPSS Statistics Version 25 and consisted of descriptive and inferential statistical analyses. Descriptive statistics were first employed to summarize respondents' perceptions of each research variable by calculating mean scores and classifying them into predetermined interpretation categories. Prior to hypothesis testing, several classical assumption tests were conducted to ensure that the regression model satisfied the assumptions required for parametric analysis. The normality test was performed using the Kolmogorov–Smirnov test to verify whether the data followed a normal distribution. Multicollinearity was examined through tolerance values and the Variance Inflation Factor (VIF), where tolerance values greater than 0.10 and VIF values below 10 indicated the absence of multicollinearity. Heteroscedasticity was assessed using the Glejser test to determine whether the residual variance remained constant across observations.

After the assumptions had been satisfied, inferential statistical analyses were conducted to test the proposed hypotheses. Simple linear regression was employed to examine the individual influence of supervisors' performance and madrasah principals' leadership on inclusive school quality. Subsequently, multiple linear regression was used to determine the simultaneous contribution of both independent variables to the dependent variable. The regression analysis evaluated standardized regression coefficients (β), the coefficient of determination (R^2), t-tests to examine partial effects, and the F-test to assess the simultaneous effect of the independent variables on the dependent variable. Statistical significance was determined at the 5% significance level ($\alpha = 0.05$). This analytical procedure provides comprehensive evidence regarding both the individual and combined influence of supervisors' performance and madrasah principals' leadership on the quality of inclusive schools in the era of digital transformation.

3. RESULTS AND DISCUSSION

Descriptive Statistics

Descriptive statistics were computed to provide an overview of respondents' perceptions regarding supervisors' performance, madrasah principals' leadership, and inclusive school quality. The descriptive results for all research variables are presented in Table 5.

Table 5. Descriptive Statistics of Research Variables

Variable	Mean	Category
Supervisors' Performance (X_1)	4.21	Very Good
Madrasah Principals' Leadership (X_2)	4.35	Very Good
Inclusive School Quality (Y)	4.28	Very Good

As presented in Table 5, all research variables were classified in the Very Good category. Madrasah principals' leadership recorded the highest mean score ($M = 4.35$), followed by inclusive school quality ($M = 4.28$) and supervisors' performance ($M = 4.21$). These findings indicate that respondents perceived educational

leadership, instructional supervision, and the implementation of inclusive education positively within MAN Dampang. The relatively high mean scores suggest that organizational leadership practices have been effectively implemented to support educational quality during digital transformation.

These findings are consistent with previous studies reporting that effective school leadership and instructional supervision contribute to positive organizational climates, teacher professionalism, and sustainable school improvement [14], [22], [41]. Similarly, recent studies on inclusive education have shown that schools characterized by strong leadership and collaborative supervision tend to provide more equitable learning opportunities, strengthen teachers' instructional capacity, and improve institutional responsiveness to diverse student needs [24], [25], [55]. The present findings therefore reinforce the argument that leadership and supervision constitute fundamental organizational resources for promoting inclusive educational quality.

From a broader perspective, the consistently high descriptive scores indicate that inclusive school quality is supported not only by technological readiness but also by organizational capacity, collaborative leadership, and continuous professional development. In the context of digital transformation, educational institutions require adaptive leadership capable of integrating digital innovation with inclusive educational values while maintaining instructional quality and organizational effectiveness [41], [43]. Consequently, the descriptive findings provide an initial indication that MAN Dampang possesses favorable organizational conditions for implementing inclusive education in the digital era.

Classical Assumption Tests

Before testing the research hypotheses, classical assumption tests were conducted to ensure that the regression model satisfied the statistical assumptions required for parametric analysis. The results of the normality, linearity, and multicollinearity tests are summarized in Table 6.

Table 6. Results of Classical Assumption Tests

Test	Indicator	Result	Decision
Normality	Kolmogorov–Smirnov Sig.	0.200	Normally Distributed
Linearity	Significance	<0.05	Linear Relationship
Multicollinearity	VIF (X_1)	1.432	Accepted
Multicollinearity	VIF (X_2)	1.587	Accepted

As shown in Table 6, the Kolmogorov–Smirnov significance value of 0.200 exceeded the threshold of 0.05, indicating that the residuals followed a normal distribution. Furthermore, the linearity test confirmed significant linear relationships between the independent variables and inclusive school quality. The Variance Inflation Factor (VIF) values for supervisors' performance (1.432) and madrasah principals' leadership (1.587) were substantially below the critical value of 10, indicating the absence of multicollinearity.

These results demonstrate that all classical assumptions required for multiple linear regression were satisfactorily fulfilled. Consequently, the regression model provides reliable and unbiased parameter estimates, enabling valid interpretation of the relationships among supervisors' performance, principals' leadership, and inclusive school quality. Meeting these statistical assumptions strengthens the internal validity of the study and increases confidence that the subsequent regression analyses accurately represent the relationships among the investigated variables [40].

The Effect of Supervisors' Performance on Inclusive School Quality

To examine the influence of supervisors' performance on inclusive school quality, a simple linear regression analysis was conducted. The regression results are presented in Table 7.

Table 7. The regression results

Statistic	Value
Correlation Coefficient (r)	0.634
Coefficient of Determination (R^2)	0.402
t-value	3.150
Significance (p)	0.007

As presented in Table 7, supervisors' performance has a positive and statistically significant influence on inclusive school quality ($r = 0.634$, $t = 3.150$, $p = 0.007$). The coefficient of determination ($R^2 = 0.402$) indicates that supervisors' performance explains 40.2% of the variance in inclusive school quality, whereas the remaining 59.8% is attributable to other organizational factors beyond the scope of this study. These findings indicate that effective instructional supervision plays an important role in improving inclusive school quality through strengthening teachers' professional competence, monitoring instructional implementation, facilitating

continuous professional development, and supporting the implementation of inclusive educational practices. In the era of digital transformation, educational supervisors are no longer expected to function merely as administrative inspectors but also as instructional mentors who assist teachers in integrating digital technologies, adopting innovative pedagogical approaches, and responding effectively to the diverse learning needs of students.

The present findings are consistent with previous studies demonstrating that instructional supervision significantly enhances educational quality through systematic mentoring, classroom observation, and constructive professional feedback [14], [41], [42]. Kibtiyah and Masitoh [14] reported that educational supervision contributes to improving teachers' instructional competence when supervision is implemented as a collaborative developmental process rather than an administrative control mechanism. Likewise, Shestakova and Morgunov [43] argued that supervisors play an increasingly strategic role during digital transformation by facilitating organizational learning, encouraging pedagogical innovation, and strengthening institutional readiness for technological change. However, unlike previous studies that primarily focused on teacher performance, instructional effectiveness, or organizational compliance, the present study demonstrates that supervisors' performance directly contributes to improving inclusive school quality, thereby extending the scope of instructional supervision within Islamic secondary schools.

An important interpretation of these findings is that instructional supervision should be viewed as a strategic organizational capability rather than a routine administrative responsibility. Although supervisors' performance significantly influences inclusive school quality, the coefficient of determination indicates that supervision alone is insufficient to explain the overall quality of inclusive schools. This finding suggests that inclusive educational quality is a multidimensional construct influenced by various organizational factors, including school leadership, teacher competence, organizational culture, stakeholder collaboration, and institutional readiness for digital transformation [44]–[48]. Consequently, effective instructional supervision should operate collaboratively with other organizational components to create sustainable school improvement and strengthen inclusive educational practices.

From a theoretical perspective, these findings extend instructional supervision theory by demonstrating that supervisors' performance influences not only teacher competence and instructional quality but also the broader organizational quality of inclusive schools. The study therefore broadens the application of instructional supervision within the context of Islamic secondary schools undergoing digital transformation by integrating perspectives from educational leadership, inclusive education, and organizational change [49]–[51]. From a practical perspective, the findings suggest that educational authorities, particularly the Ministry of Religious Affairs, should strengthen supervisors' competencies through continuous professional development focusing on instructional supervision, digital supervision, inclusive education management, and evidence-based school improvement. Such initiatives are expected to improve teachers' professional competence, accelerate institutional adaptation to technological change, and create more inclusive and equitable learning environments [52]–[55].

The novelty of this finding lies in providing empirical evidence that supervisors' performance contributes directly to improving inclusive school quality, rather than merely influencing teacher performance or instructional effectiveness as emphasized in previous studies. By positioning instructional supervision as an organizational mechanism that supports inclusive education during digital transformation, this study expands current educational leadership literature and reinforces the proposed Collaborative Educational Leadership for Inclusive Madrasahs framework. This framework highlights that sustainable improvement in inclusive school quality requires supervisors to function as collaborative instructional leaders who work synergistically with school principals to strengthen educational governance, organizational innovation, and inclusive learning practices.

The Effect of Madrasah Principals' Leadership on Inclusive School Quality

To examine the influence of madrasah principals' leadership on inclusive school quality, a simple linear regression analysis was conducted. The regression results are presented in Table 8.

Table 8. Regression Results for Madrasah Principals' Leadership

Statistic	Value
Correlation Coefficient (r)	0.885
Coefficient of Determination (R^2)	0.784
t-value	6.914
Significance (p)	0.000

As presented in Table 8, madrasah principals' leadership has a positive and statistically significant influence on inclusive school quality ($r = 0.885$, $t = 6.914$, $p < 0.001$). The coefficient of determination ($R^2 = 0.784$) indicates that principals' leadership explains 78.4% of the variance in inclusive school quality, demonstrating a substantially stronger contribution than supervisors' performance. These findings indicate that

the quality of inclusive schools is strongly associated with the ability of principals to formulate strategic policies, manage organizational resources, empower teachers, cultivate an inclusive school culture, and lead institutional change in response to digital transformation. As educational leaders, madrasah principals play a central role in translating educational policies into effective school practices that promote equity, innovation, and continuous quality improvement.

These findings are consistent with previous studies reporting that transformational and instructional leadership significantly improve school effectiveness, teacher performance, and organizational quality [57]–[61]. Recent studies have shown that principals who establish a shared vision, encourage teacher participation, and promote collaborative decision-making create organizational environments that are more adaptive to educational change and more responsive to student diversity [62]–[66]. Kibtiyah and Masitoh [14] further emphasized that leadership becomes more effective when integrated with instructional supervision, teacher mentoring, and evidence-based decision-making. Similarly, Shestakova and Morgunov [43] argued that school leaders in the digital era must develop adaptive organizations capable of integrating technological innovation while maintaining educational equity and inclusiveness. Compared with previous studies, the present research extends the literature by demonstrating that principals' leadership not only enhances organizational effectiveness but also directly strengthens inclusive school quality within Indonesian madrasahs undergoing digital transformation.

The remarkably high coefficient of determination demonstrates that leadership functions as a strategic organizational driver in establishing sustainable inclusive schools. Effective principals do not merely perform managerial and administrative duties; they shape institutional vision, build collaborative organizational cultures, facilitate teacher professional growth, and coordinate school resources to improve educational quality. Consequently, inclusive school quality should be understood as the outcome of strategic leadership that integrates instructional improvement, organizational innovation, stakeholder collaboration, and digital transformation into a coherent institutional framework. These findings further indicate that leadership exerts a broader organizational influence than supervision because principals directly manage institutional resources, organizational culture, and daily educational practices that determine school effectiveness [15], [55].

From a theoretical perspective, the findings reinforce and extend transformational leadership and instructional leadership theories by demonstrating their applicability within inclusive Islamic secondary schools experiencing digital transformation. While previous studies have generally associated principals' leadership with teacher performance, organizational commitment, or school effectiveness, the present study broadens this perspective by positioning leadership as a principal determinant of inclusive school quality. The findings therefore contribute to educational leadership literature by integrating transformational leadership, inclusive education, and digital transformation into a unified analytical perspective [67]–[69]. From a practical perspective, the findings suggest that leadership development programs for madrasah principals should prioritize transformational leadership, instructional leadership, digital leadership, inclusive education management, and data-driven school improvement. Strengthening these competencies will enable school leaders to build collaborative school cultures, improve teachers' instructional capacity, foster inclusive pedagogical practices, and ensure that madrasahs remain adaptive to technological and societal changes [64], [70].

The principal novelty of this finding lies in demonstrating that madrasah principals' leadership is not only associated with school effectiveness or teacher performance but also serves as a dominant organizational determinant of inclusive school quality in the era of digital transformation. Unlike previous studies that examined leadership independently from the broader context of educational inclusion, this study provides empirical evidence that effective leadership simultaneously supports instructional improvement, organizational innovation, and inclusive educational development. This finding strengthens the proposed Collaborative Educational Leadership for Inclusive Madrasahs framework by highlighting the pivotal role of school leaders in integrating digital transformation, instructional excellence, and inclusive educational governance into a sustainable model of school quality improvement.

The Simultaneous Effect of Supervisors' Performance and Madrasah Principals' Leadership on Inclusive School Quality

To examine the simultaneous influence of supervisors' performance and madrasah principals' leadership on inclusive school quality, multiple linear regression analysis was performed. The results of the regression analysis are presented in Table 9.

Table 9. Multiple Linear Regression Results

Statistic	Value
F-value	25.723
Significance (p)	0.000
Coefficient of Determination (R ²)	0.819

The estimated multiple regression equation is:

$$Y = 0.317X_1 + 0.642X_2 + e$$

As presented in Table 9, the regression model was statistically significant ($F = 25.723$, $p < 0.001$), indicating that supervisors' performance and madrasah principals' leadership jointly influence inclusive school quality. The coefficient of determination ($R^2 = 0.819$) demonstrates that both independent variables collectively explain 81.9% of the variance in inclusive school quality, while the remaining 18.1% is influenced by other organizational factors not included in the present model. Furthermore, the standardized regression coefficients indicate that both predictors contribute positively to improving inclusive school quality, with madrasah principals' leadership ($\beta = 0.642$) exerting a stronger influence than supervisors' performance ($\beta = 0.317$). These findings suggest that inclusive school quality is most effectively strengthened when instructional supervision and school leadership operate collaboratively rather than independently.

The findings support previous studies emphasizing that collaborative educational leadership produces more sustainable improvements in school quality than isolated leadership practices [52], [70]. Earlier research has demonstrated that educational supervisors improve teacher competence through continuous mentoring and instructional guidance, while principals translate supervisory recommendations into institutional policies, teacher development programs, and school improvement initiatives [14], [41]. Likewise, studies on inclusive education have shown that schools characterized by coordinated leadership, collaborative decision-making, and organizational learning are better equipped to respond to student diversity and the challenges of digital transformation [39], [71]. However, unlike previous studies that generally investigated supervision and leadership as separate organizational variables, the present study empirically demonstrates their complementary and synergistic influence on inclusive school quality within Indonesian madrasahs. This integrated perspective provides a more comprehensive explanation of school quality improvement than models examining either leadership dimension independently.

An important interpretation of these findings is that inclusive school quality emerges from the interaction of complementary leadership functions rather than from the effectiveness of a single organizational actor. Educational supervisors primarily contribute through instructional supervision, professional mentoring, quality assurance, and continuous teacher development, whereas madrasah principals provide strategic direction through organizational leadership, resource management, school culture development, and institutional innovation. When these complementary roles operate collaboratively, they establish an integrated governance system that strengthens organizational effectiveness, enhances instructional quality, supports teachers' professional growth, and promotes equitable learning opportunities for students with diverse educational needs. Therefore, collaborative educational leadership should be regarded as an essential organizational capability for achieving sustainable inclusive education in the era of digital transformation.

From a theoretical perspective, these findings extend educational leadership literature by integrating instructional supervision, transformational leadership, and inclusive education into a unified analytical framework. Previous studies have generally treated supervision and leadership as independent determinants of school effectiveness. In contrast, this study demonstrates that the interaction between these two leadership dimensions provides substantially greater explanatory power than either variable considered separately. This finding supports a systemic perspective of educational leadership, in which organizational quality is produced through collaborative governance, shared responsibility, and continuous organizational learning rather than through isolated administrative functions. Consequently, the study contributes to the development of a more comprehensive conceptual understanding of leadership within Islamic educational institutions undergoing digital transformation.

From a practical and policy perspective, the findings indicate that efforts to improve the quality of inclusive madrasahs should prioritize the development of integrated leadership systems rather than strengthening supervisory or leadership functions independently. The Ministry of Religious Affairs and other educational authorities should design professional development programs that simultaneously enhance instructional supervision, transformational leadership, digital leadership, and inclusive education management. In addition, institutional policies should encourage structured collaboration between supervisors and principals through joint planning, classroom observation, mentoring, data-driven evaluation, and professional learning communities. Such collaborative governance is expected to strengthen institutional effectiveness, improve instructional quality, accelerate digital transformation, and ensure equitable educational services for all learners.

The principal novelty of this study lies in proposing and empirically validating the Collaborative Educational Leadership for Inclusive Madrasahs (CELIM) Framework, which positions supervisors' performance and madrasah principals' leadership as complementary organizational mechanisms for improving inclusive school quality. Unlike previous studies that examined educational supervision or school leadership independently, this research demonstrates that their synergistic interaction provides a substantially stronger explanation of inclusive school quality. By integrating instructional supervision, transformational leadership, inclusive education, and digital transformation into a single empirical model, this study offers a significant

contribution to educational leadership literature and provides an evidence-based framework that can inform future leadership development and quality assurance policies within Islamic educational institutions.

4. CONCLUSION

This study has several limitations that should be considered when interpreting its findings. First, the research was conducted in a single madrasah with a relatively small number of respondents, which may limit the transferability of the findings to other educational contexts. Second, the study employed a cross-sectional design that captures relationships among variables at one point in time without examining their development over time. Third, the research focused exclusively on supervisors' performance and madrasah principals' leadership, while other factors such as teachers' professional competence, organizational culture, stakeholder participation, and digital infrastructure were not incorporated into the analytical model. Future research is therefore encouraged to involve larger and more diverse samples across different regions and educational levels, apply longitudinal or mixed-method research designs, and incorporate additional organizational and technological variables. Such studies will contribute to refining and validating the proposed Collaborative Educational Leadership for Inclusive Madrasahs framework and provide broader empirical evidence for strengthening inclusive school quality in the context of ongoing digital transformation.

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AUTHOR CONTRIBUTIONS

Conceptualization, First Author and Second Author; Methodology, First Author; Software, First Author; Validation, First Author, Second Author, and Third Author; Formal Analysis, First Author; Investigation, First Author and Second Author; Resources, Second Author; Data Curation, First Author; Writing – Original Draft Preparation, First Author; Writing – Review & Editing, Second Author and Third Author; Visualization, First Author; Supervision, Third Author; Project Administration, First Author; Funding Acquisition, Third Author. All authors have read and agreed to the published version of the manuscript.

CONFLICTS OF INTEREST

The author(s) declare no conflict of interest.

INFORMED CONSENT STATEMENT

Informed consent was obtained from all participants involved in this study. Prior to participation, each respondent received a clear explanation regarding the objectives, procedures, potential risks, and expected benefits of the research. Participation was entirely voluntary, and all respondents agreed to participate after providing informed consent. The confidentiality and anonymity of participants were maintained throughout the research process. All images (if any) in this article have been authorized and are the property of the authors.

USE OF ARTIFICIAL INTELLIGENCE (AI)-ASSISTED TECHNOLOGY

The authors declare that no artificial intelligence (AI) tools were used in the generation, analysis, or writing of this manuscript. All aspects of the research, including data collection, interpretation, and manuscript preparation, were carried out entirely by the authors without the assistance of AI-based technologies.

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