

Digital Innovation in Madrasah Governance: Redefining Managerial Supervision through A System-Driven Framework

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DOI: <http://doi.org/10.33650/al-tanzim.v11i1.15851>

Received: 11 June 2026

Revised: 20 August 2026

Accepted: 02 October 2026

Abstract:

This study aims to analyze the digital-based managerial supervision innovation model developed in madrasah. It employs a qualitative approach with a multi-site study design, focusing on madrasahs that have implemented digital-based supervision innovations. Data were collected through in-depth interviews, field observations, and document analysis, and subsequently analyzed using data reduction, data display, and interpretive conclusion-drawing. The results indicate that managerial supervision has shifted from an administrative oversight pattern to a data-driven supervision system that uses digital technology as an instrument for quality control. The findings identify three key patterns: (1) a paradigm shift toward "System-Driven Supervision," which positions data as the foundation for decision-making; (2) creating a multi-platform ecosystem with digital platforms and supporting applications for management functions; and (3) the development of oversight mechanisms via real-time dashboards and hybrid communication that integrates digital monitoring with direct interaction. The study implies that digital transformation in supervision requires not only technological readiness but also adaptive leadership, stronger human resource digital competencies, and a data-driven organizational culture. Theoretically, this research expands the understanding of digital supervision as a quality governance model that is integrative, collaborative, and oriented toward institutional sustainability.

Keywords: *Digital Managerial Supervision, System-Driven Supervision, Multi-platform Ecosystem*

Abstrak:

Penelitian ini bertujuan untuk menganalisis tentang model inovasi supervisi manajerial berbasis digital yang dikembangkan di madrasah. Penelitian ini menggunakan pendekatan kualitatif dengan desain studi multisitus pada lembaga madrasah yang telah menerapkan inovasi supervisi berbasis digital. Data penelitian diperoleh melalui wawancara mendalam, observasi lapangan, dan studi dokumentasi, kemudian dianalisis melalui tahapan reduksi data, penyajian data, serta penarikan kesimpulan secara interpretatif. Hasil penelitian menunjukkan bahwa transformasi supervisi manajerial telah mengalami pergeseran dari pola pengawasan administratif menuju sistem supervisi berbasis data yang menjadikan teknologi digital sebagai instrumen pengendalian mutu. Temuan penelitian mengidentifikasi tiga pola utama, yaitu (1) perubahan paradigma menuju System-Driven Supervision yang menempatkan data sebagai dasar pengambilan keputusan; (2) terbentuknya ekosistem multiplatform melalui pemanfaatan EMIS,

SIMPATIKA, e-RKAM, RDM, Google Workspace, dan aplikasi pendukung lainnya untuk mendukung fungsi manajemen; serta (3) berkembangnya mekanisme pengawasan melalui dashboard real-time dan komunikasi hibrida yang mengintegrasikan pemantauan digital dengan interaksi langsung. Implikasi penelitian ini menunjukkan bahwa transformasi digital dalam supervisi tidak hanya membutuhkan kesiapan teknologi, tetapi juga kepemimpinan adaptif, penguatan kompetensi digital sumber daya manusia, serta pembangunan budaya organisasi berbasis data. Secara teoritis, penelitian ini memperluas pemahaman tentang supervisi digital sebagai model tata kelola mutu yang integratif, kolaboratif, dan berorientasi pada keberlanjutan kelembagaan.

Kata Kunci: *Supervisi Manajerial Digital; System-Driven Supervision, Ekosistem Multiplatform*

Please cite this article in APA style as:

Muanifah, S., Rodliyah, S., Umam, K., & Sain, Z. H. (2027). Digital Innovation in Madrasah Governance: Redefining Managerial Supervision Through a System-Driven Framework. *Al-Tanzim: Jurnal Manajemen Pendidikan Islam*, 11(1), 30-45.

INTRODUCTION

Advancements in digital technology have shifted the paradigm of educational organization management across countries (Enachescu, 2025; Hidayat et al., 2024; Hosna et al., 2025). Digitalization in the education sector is no longer viewed merely as the use of technological devices, but as a comprehensive transformation of planning systems, decision-making processes, resource management, and institutional quality improvement mechanisms (Imamiyah et al., 2026; Maulia et al., 2026; Sudrajat et al., 2026). This shift is crucial because modern educational organizations must have a strong capacity to adapt to social dynamics and technological developments (Allam et al., 2025; Ul Hassan et al., 2025). Reports from UNESCO and the OECD indicate that using technology in educational governance improves management effectiveness, information transparency, and a stronger culture of data-driven evaluation. Consequently, digital transformation has become a strategic necessity for educational institutions to build organizational systems that are responsive, accountable, and sustainable amid global challenges (Islamiyah, 2025; Widad & Suliyanto, 2025; Yoeliyanto et al., 2025).

In modern educational organizations, implementing data-driven management is a vital approach to improving institutional governance quality (Buttow, 2025; Chigbu & Makapela, 2025). Digitally available data enables educational leaders to conduct more objective analyses when formulating policies, evaluating performance, and designing organizational development strategies. This demonstrates that technology functions not only as an administrative support tool but also as a strategic instrument for establishing effective leadership and supervision systems. Studies on "learning organizations" further emphasize that an institution's success relies heavily on its ability to foster continuous processes of reflection, evaluation, and improvement (Iqbal et al., 2025; Tariq, 2025). Thus, integrating technology into educational management must aim to cultivate an organizational culture capable of adaptive learning and growth.

Although digital transformation offers numerous opportunities to improve education quality, its implementation still faces various organizational challenges. Key issues stem not only from limited technological infrastructure but also from concerns regarding human resource readiness, leadership styles, organizational culture, and supervision mechanisms that have yet to align with the demands of

the digital era. In many educational institutions, technology use remains confined to administrative and instructional functions, while its application to support organizational development has not been optimized. This gap reveals a disconnect between technology availability and an institution's capacity to manage change. As a result, digital innovation is often piecemeal, dependent on specific individuals, and has yet to become part of a sustainable management system.

Previous studies have explored the relationship between the digitalization of education, leadership, and institutional quality improvement (Dermawan et al., 2024; Fadliah & Putri, 2026; Suratman & Sugiyono, 2025; Wadi et al., 2023). Research on educational supervision indicates that supervision plays a crucial role in building organizational capacity through processes of guidance, evaluation, and professional human resource development (Lamatenggo & Suling, 2026; Mus et al., 2026; Nugraha, 2025). Meanwhile, research on digital transformation has largely focused on technology use in instruction, academic information systems, and educational service innovation. However, most of these studies view digitalization primarily as a technical phenomenon and have not examined how technology can be integrated into managerial supervision systems as a mechanism for organizational development. These limitations suggest that the interplay between digital technology, organizational culture, and supervisory practices requires further in-depth study, particularly within religious-based educational institutions.

In the context of madrasahs (Islamic schools), prior research indicates that institutional characteristics and prevailing leadership patterns heavily influence the success of digital transformation. Some studies reveal that madrasah digitalization often proceeds via a structural approach driven by government policy (Hamdanah, 2025; Mas'ud et al., 2026; Rohim et al., 2026; Safaruddin et al., 2026). In contrast, others emphasize the importance of local leadership and organizational culture in technology adoption. Yet, research integrating these two perspectives remains limited. Few studies explain how managerial supervision can integrate formal systems, institutional values, organizational culture, and leadership in creating digital madrasahs. Consequently, research is needed to develop a comprehensive understanding of digital-based managerial supervision models applicable to madrasahs with diverse characteristics.

Given this context, this study offers a novel contribution by developing an innovative managerial supervision model for digital madrasahs that integrates the dimensions of organizational systems, institutional culture, and leadership. The study is grounded in the argument that the success of digital transformation in madrasahs depends not solely on the presence of technology, but on the organization's ability to manage change through structured and sustainable supervision mechanisms. Studying MIN 3 Banyuwangi and MI NU Tegalsari Banyuwangi is significant because these two institutions represent distinct transformational characteristics: a formal, system-based approach and a leadership culture-based approach. Consequently, this research aims to examine how a digital-based managerial supervision innovation model can be developed in the context of madrasahs with different institutional characteristics, and how

such a model can strengthen Islamic educational governance in a way that is adaptive to contemporary developments.

RESEARCH METHODS

This study employs a qualitative approach (Köhler, 2024; Razafsha et al., 2022) with a multi-site case study design. This approach was selected because the research aims to gain an in-depth understanding of the managerial supervision innovation process – specifically through the development of digital madrasahs – as a phenomenon involving organizational, leadership, work culture, and institutional practice aspects. A qualitative approach enables the researcher to understand the meanings, strategies, and dynamics involved from the perspectives of the actors directly participating in the madrasah digital transformation process. A multi-site case study design was used because the research involves two institutions with distinct characteristics; this allows analysis at each location as well as cross-case analysis to identify patterns, similarities, and differences in the development of digital-based managerial supervision.

The research was conducted at MIN 3 Banyuwangi and MI NU Tegalsari in Banyuwangi Regency. The selection of these two sites was based on both empirical and theoretical considerations: both institutions have implemented technology in their institutional management, administration, communication, and supervision processes. Furthermore, the two madrasahs possess different organizational characteristics, thereby offering a broader scope for examining patterns of digital-based managerial supervision innovation. MIN 3 Banyuwangi represents a public madrasah characterized by a robust formal bureaucratic system and an orientation toward institutional regulations. In contrast, MI NU Tegalsari represents a private, religious organization-based madrasah with a more flexible and participatory work culture. These contextual differences serve as a crucial basis for understanding how systemic factors, organizational culture, and leadership influence the success of digital madrasah development.

Data collection used in-depth interviews, observation, and document analysis (Karunarathna et al., 2024; Neupane et al., 2026). Interviews were used to explore the informants' experiences, views, and interpretations regarding the planning, implementation, evaluation, and sustainability of digital-based managerial supervision. Informants were purposively selected based on their involvement in and understanding of the research phenomenon; these included madrasa principals, supervisors, teachers, educational staff, and the madrasa's technology management team. Observations provided a factual overview of supervision practices, the use of digital systems, organizational communication patterns, and interactions among actors within the madrasa environment. Meanwhile, the study used documentation to analyze written sources such as internal policies, supervision reports, standard operating procedures, digital archives, and other supporting documents. These techniques aimed to generate comprehensive data and strengthen the credibility of the findings through triangulation of sources and methods.

Data analysis was conducted interactively and continuously using the Miles, Huberman, and Saldaña model, which encompasses data collection, data condensation, data display, and conclusion drawing and verification (Asipi et al.,

2022; Salmona & Kaczynski, 2024). The analysis proceeded in two stages: within-case analysis to understand each madrasa's characteristics, and cross-case analysis to identify common patterns and contextual differences across the research sites. The study ensured data validity by applying four trustworthiness criteria: credibility, transferability, dependability, and confirmability. Credibility was reinforced through source triangulation, technique triangulation, and member checks, while transferability was addressed by providing an in-depth description of the research context. Additionally, the research process was documented (audit trail) to ensure consistency and traceability at each stage, supporting the scientific accountability of the results.

RESULTS AND DISCUSSION

Results

Paradigm Shift Toward Data-Driven, System-Driven Supervision

In this study, the paradigm shift toward data-driven, System-Driven Supervision is operationally defined as a transformation in managerial supervision practices—moving away from conventional oversight focused on administrative checks and toward a control and guidance system that utilizes digital data as the foundation for monitoring, evaluation, and decision-making. These findings indicate that supervision is no longer conducted sporadically through inspections of physical documents; instead, it has evolved into a structured mechanism that uses digital platforms such as EMIS, EDM, ERKAM, RDM, Google Workspace, and other support systems. Digital data serves as an information source for assessing the *madrasah's* condition, identifying needs, and determining appropriate follow-up actions more objectively. Interviews with a madrasah principal revealed that digital-based supervision is understood not merely as an administrative inspection activity, but as a quality assurance process that leverages data in madrasah management (inf_ari_1). The informant explained that digital systems foster greater orderliness, transparency, and easier monitoring, as all management processes—from needs assessment and policy formulation to facilities management and program implementation—can be managed collaboratively. Based on this statement, the paradigm shift in supervision centers on work orientation: moving from supervision that merely assesses administrative completeness to supervision that uses data-driven information to strengthen the principal's managerial functions.

An education staff member at one of the madrasahs noted that digital systems strengthen information management processes and facilitate connectivity between different departments within the institution (inf_sft_13). The informant explained that EMIS serves as the primary database, while EDM and ERKAM support planning and budget management; administrative documents are stored on Google Drive, ensuring easy retrieval when needed. The researchers interpret this as indicating that System-Driven Supervision is built on the availability of documented, accessible data that supports the monitoring process. Thus, technology serves not merely as an administrative tool but as an infrastructure enabling the madrasah head to conduct supervision more rapidly and on an evidence-based footing.

Observational findings indicate a shift in managerial supervision from manual methods to data-driven oversight. madrasah heads no longer rely solely on physical copies of teachers' administrative documents; instead, they monitor progress periodically via digital dashboards. These systems allow them to track the completeness of instructional materials, student learning outcome reports, and the status of administrative tasks. This shows that digital dashboards support a more sustainable supervision process, as information is accessible without the delays inherent in manual review.

The data suggests a common thread: the transition toward "System-Driven Supervision" stems from a fundamental shift in how the madrasah perceives the supervision function. Supervision is no longer viewed merely as a mechanism for policing administrative errors but as a quality management system that leverages data to plan, monitor, evaluate, and improve madrasah programs. This is evidenced by the use of monitoring dashboards, automated data management, and digital feedback mechanisms – tools that transform manual inspections into a supervision process that is standardized, transparent, objective, and sustainable.

Data-driven, system-driven supervision is characterized by three key elements: technology integration, data-informed decision-making, and a shift in work culture toward continuous monitoring. Digital data does not supplant the madrasah head's leadership role; rather, it enhances their ability to assess the institution's status and determine appropriate actions. Consequently, the resulting supervision model represents more than just the digitization of documents; it signifies a transformation of work systems that establishes data as the cornerstone of quality control within the madrasah.

Integration of A Multi-Platform Ecosystem in Institutional Governance

In this study, the integration of a multiplatform ecosystem within institutional governance is defined as the process of unifying the various digital applications and devices used by *madrasahs* to support all management functions—ranging from planning, organizing, and implementation to supervision and program evaluation. This integration does not imply the use of a single, all-encompassing system; rather, it signifies the interconnection of various platforms that serve distinct yet complementary functions in providing information for madrasah management.

According to one madrasah principal, a significant amount of madrasah data is now entered into systems such as EMIS, SIMPATIKA, RDM, and e-RKAM. "When program meetings are held, I prepare the necessary data and report on technical conditions—such as the need to strengthen network connectivity, insufficient computer hardware, or the requirement to update specific applications. Based on this information, the madrasah can determine its priorities."

Table 1 shows that using various digital platforms reflects a shift in institutional governance—from fragmented administrative systems to interconnected, data-driven management. EMIS serves as a central hub for managing data regarding the institution, students, and other supporting information, while RDM is used to manage student learning outcomes and academic administration. Meanwhile, e-RKAM and EDM support the processes of planning, budgeting, and evaluating madrasah quality by providing more structured information.

Table 1. Digital Ecosystem in Madrasah

	EMIS Application
	Madrasah Digital Report Card (RDM) Application
	E-RKAM Application
	EDM Summary

The integration of these applications demonstrates that data is no longer merely an administrative record; it has evolved into a strategic information resource for determining policy direction and development priorities for the madrasah. Statements from informants—indicating that data from these various systems is used in program meetings to identify needs regarding networks, hardware, and application updates—show that the digital ecosystem functions as an instrument for evidence-based decision-making.

Table 2. Results of Interviews with Informants

Interview Excerpts	Indicators	Informant
“EMIS serves as the madrasah’s primary data repository, while EDM, ERKAM, and Google Drive support budgeting and administrative document management.”	Digital platform utilization for data management, budgeting, and administrative	(Education Staff/Madrasah Operator)

	documentation.	
"Madrasah data are increasingly managed through systems such as EMIS, SIMPATIKA, RDM, and e-RKAM, providing essential information for program planning and technical decision-making."	Availability of digital data for program formulation and the determination of institutional priorities	(Madrasah Operator)
"The committee provides input, particularly regarding programs and facility requirements. Information from the madrasah also flows more quickly now, as it can be conveyed via WhatsApp or digital documents."	Use of digital media for communication, transparency, and stakeholder engagement	(Madrasah Committee)

Table 2 illustrates that each application plays a specific role in supporting institutional governance. EMIS and SIMPATIKA serve as sources for managing institutional and human resource data; e-RKAM supports planning and budgeting; and RDM manages student learning outcomes. The existence of these various platforms demonstrates that madrasahs no longer rely on a single administrative source but instead build an information network distributed across multiple systems tailored to the needs of specific functional areas. This pattern reflects a division of digital functions, enabling each work unit to receive technological support aligned with its specific responsibilities.

Multi-platform integration involves not only using applications but also changing organizational workflows. Data available across these systems serves as a basis for discussions during meetings, program development, and decision-making. Operators play a crucial role as intermediaries between digital systems and leadership's managerial needs, as they provide necessary technical information. However, this integration remains functional and adaptive rather than fully technical, as the applications are not yet interconnected within a single automated system. This suggests that the success of the digital ecosystem still depends on users' ability to process, interpret, and synthesize information from various platforms.

As evidenced by field data, the use of digital platforms has permeated various core madrasah activities. Researchers found that institutional administration relies on EMIS, SIMPATIKA, e-RKAM, and RDM, while learning activities are supported by Google Workspace, Canva, audiovisual media, and Computer-Based Tests (CBT). Additionally, WhatsApp serves as the primary communication medium for daily coordination among teachers, educational staff, the school committee, and parents. This indicates that the multi-platform ecosystem has fostered a more flexible governance model, allowing information to flow through various channels according to organizational needs.

Overall, the integration of a multi-platform ecosystem into institutional governance demonstrates that madrasah digitalization is evolving through the use of various complementary systems. Digital platforms serve as supporting tools to provide data, accelerate administrative services, strengthen communication, and assist leadership in policy formulation. Thus, this integration represents more than just the simultaneous use of technologies; it is an institutional management strategy that links data, stakeholders, and work processes within an information-based governance framework.

At least three key features characterize multi-platform ecosystem integration. First is the pattern of functional differentiation, where specific applications are utilized to meet the needs of distinct areas such as administration, finance, academics, and communication. Second is the pattern of information connectivity, where data from various systems is leveraged collectively to support program planning and evaluation. Third is the pattern of organizational adaptation, where technology usage is tailored to user capacity, available infrastructure, and the specific needs of the madrasah (Islamic school). These patterns demonstrate that a digital ecosystem for institutional governance is not built around a single master application, but rather through a network of platforms that gradually shape a more effective, transparent, and responsive madrasah operational system.

Real-time Dashboard-Based Monitoring and Hybrid Communication

In this study, real-time dashboard-based supervision and hybrid communication are defined as a shift in managerial supervision mechanisms that combines the use of digital systems for rapid data monitoring with direct interaction – whether face-to-face or via online media. In practice, supervision no longer relies entirely on reviewing physical documents or periodic reports; instead, it uses access to digital data that can be continuously updated and monitored. Meanwhile, hybrid communication blends direct coordination – such as meetings or coaching sessions – with app-based communication (e.g., WhatsApp) to speed up information sharing, problem-solving, and supervisory follow-up.

Table 3. Results of Interviews with Informants

Interview Excerpts	Indicators of Findings	Informants	Significance of Data
"Coordination is conducted through WhatsApp groups and digital channels, while regular evaluation meetings use digital data to address challenges and determine solutions."	Hybrid communication combining digital media and face-to-face meetings	Madrasah Head	Digital media accelerates coordination, while face-to-face meetings are used for evaluation and collaborative decision-making.
"The madrasa head conducts regular supervision by directly observing classroom instruction, checking the completeness of teachers' administrative records, and discussing the implementation of lessons."	Supervision combining direct monitoring with administrative reviews	Education Personnel	Supervision maintains personal interaction despite being supported by digital systems.
"The madrasa head continues classroom observations and administrative checks, while digital systems facilitate document management, CBT-based assessments, and RDM-based report processing."	Integration of conventional oversight and digital technology	Deputy Head of Madrasah	Digitalization speeds up document management and evaluation without eliminating direct observation.

Table 3 indicates that real-time, dashboard-based supervision has transformed how leadership obtains information regarding the *madrasah's* status. Supervision data is no longer gathered solely through written reports submitted after activities conclude; instead, digital systems enable faster monitoring of work progress. At MIN 3 Banyuwangi, the head of the madrasah utilizes an integrated supervision dashboard to track teacher administration, the completeness of instructional materials, and student learning outcome reports. The dashboard supports a preventive supervision model, as leadership can identify issues early—before they escalate into major obstacles. Beyond the technological aspect, interview results reveal that supervision effectiveness does not rely entirely on digital systems. Hybrid communication plays a crucial role, as the available data still requires interpretation through dialogue and interaction among the stakeholders involved. WhatsApp facilitates rapid information dissemination and daily coordination. At the same time, evaluation meetings and face-to-face interactions provide space to discuss the meaning of the data, determine solutions, and reach consensus. The researcher views this as a form of supervision that combines technological efficiency with a relational approach; consequently, supervision focuses not only on achieving specific indicators but also on the process of mentoring and supporting the madrasah community.

Managerial supervision has shifted toward a data-driven system. The researcher found that the head of the madrasah no longer requires teachers to bring all administrative documents in hard copy; instead, monitoring is conducted via digital tools that present information more conveniently. Digital dashboards are used to track administrative compliance, teacher work progress, and the need for follow-up actions. Furthermore, observations indicate that inter-departmental coordination has become more flexible, as information regarding programs, schedule changes, and supervision follow-ups can be conveyed via digital communication channels without waiting for formal meetings. Based on these findings, the researcher concludes that combining digital dashboards with hybrid communication creates a supervision system that is both responsive and adaptive to institutional dynamics. Overall, real-time, dashboard-based monitoring and hybrid communication demonstrate that managerial supervision has evolved into a control mechanism that leverages data while preserving the role of human communication. Digital systems provide rapid, documented information, while direct and online communication clarify field conditions and guide corrective actions. Thus, supervision not only ensures administrative compliance but also improves quality through continuous monitoring, reflection, and follow-up.

Discussion

Research results indicate that managerial supervision in madrasahs (Islamic schools) has shifted from an administrative approach to a data-based, "System-Driven Supervision" model that uses digital technology, multi-platform integration, and real-time, dashboard-based monitoring. These findings align with explanations that digital supervision enhances oversight effectiveness through the direct use of learning data, online systems, and more responsive information management (Bagherifam et al., 2025; Ningsih et al., 2025). However, this study

builds on those findings by showing that digital supervision extends beyond instruction into institutional governance, using systems such as EMIS, EDM, ERKAM, RDM, and Google Workspace, along with various digital communication tools. Thus, this study contributes to a broader understanding that digital supervision in the madrasah context is not merely a monitoring instrument but a quality management system that integrates data, organizational stakeholders, and decision-making processes.

The findings regarding the integration of a multi-platform ecosystem are consistent with the concept of *data-driven decision-making*, which emphasizes the role of data as the primary foundation for organizational policy formulation. This perspective highlights that supervision dashboards can transform supervision from merely administrative activities into an evidence-based decision-support system (Kulkarni et al., 2025; Shorbaji et al., 2026; Talukder, 2025). Consistent with that research, this study finds that the various digital applications used in madrasahs do not operate in isolation but serve complementary functions in supporting planning, budgeting, academic management, and program evaluation. The distinction is that while previous research emphasized the conceptual design of dashboards as integrated systems, this study shows that field implementation remains at the stage of functional integration—characterized by inter-platform connectivity facilitated by user roles, work procedures, and organizational coordination mechanisms.

The use of real-time dashboards in this study demonstrates that supervision has evolved into a continuous monitoring process, enabling leaders to rapidly access information regarding teacher performance and the implementation of madrasah programs. These findings align with research indicating that digital supervision tools—such as e-supervision systems, dashboards, and data-driven evaluation applications—improve the efficiency, transparency, and accuracy of oversight (Badawy et al., 2026; Satori & Ulfa, 2025). However, this study identifies another dimension: hybrid communication that preserves human interaction through meetings, direct mentoring, and personal discussions. This indicates that digital transformation does not eliminate the relational aspect of supervision; rather, it combines technological advantages with an interpersonal approach. Theoretically, these findings suggest that digital supervision is a hybrid model that integrates information systems with human leadership.

From an educational leadership perspective, this study reinforces the view that the success of digital transformation depends heavily on the madrasah principal's capacity to steer organizational change. Literature on managerial supervision in the digital era highlights the pivotal role of transformational leadership in fostering an adaptive culture, driving innovation, and using technology to improve educational quality. The study's findings support this perspective, as madrasah principals act not merely as technology users but as catalysts for change, connecting operators, teachers, educational staff, the school committee, and various other stakeholders. In practical terms, the study shows that successful digitalization of supervision requires leadership that integrates technological competence, data management, and human resource development.

This study also finds that implementing digital supervision faces several challenges, such as reliance on operator skills, infrastructure limitations, varying levels of digital literacy, and the need to balance technological efficiency with social relationships within the organization. These findings align with research showing that digital-based supervision offers flexibility and effective guidance, yet still requires infrastructure support and stronger user competence (Ningsih et al., 2025; Rasdiana et al., 2026; Rosida et al., 2026). This study differs by emphasizing the madrasah context, highlighting that values of kinship, direct communication, and interpersonal relationships remain crucial factors in sustaining digital innovation. Consequently, educational institutions must develop digitalization strategies that go beyond providing applications; they must also strengthen human resource capacity and establish work procedures that support system sustainability.

Overall, this study makes a theoretical contribution by reinforcing the concept of digital supervision as a data-driven, multi-platform, and communicative managerial ecosystem. The findings expand on previous studies – which often viewed the digitalization of supervision merely as a change in tools or the adoption of applications – by showing that the transformation represents a paradigm shift in institutional management. Supervision is no longer understood solely as an administrative inspection activity but has evolved into a predictive, collaborative, and sustainable quality-control mechanism. In practical terms, the identified model can serve as a reference for madrasahs and other educational institutions developing digital governance, focusing on three key aspects: information system readiness, change leadership, and the strengthening of organizational culture. Thus, technology does not replace the human role; it enables institutions to build capacity and improve educational quality.

CONCLUSION

This study concludes that the transformation of digital-based managerial supervision in madrasahs has shifted the paradigm from a conventional administrative approach to "System-Driven Supervision," which establishes data as the primary foundation for institutional quality control. This transformation is achieved through integrating a multi-platform ecosystem, using real-time dashboards, and implementing hybrid communication that combines technological efficiency with the power of human interaction. Research findings indicate that the digitalization of supervision is not merely adopting applications, but a shift in governance systems that links data, workflows, and decision-making in a more transparent, adaptive, and sustainable way. Theoretically, this study contributes by expanding the concept of digital supervision into a data-driven quality management model that is integrative, collaborative, and human-centered. Practically, the findings offer recommendations for educational institution administrators to build integrated digital infrastructure, strengthen the digital literacy of educators and educational staff, and foster transformational leadership to sustain digital innovation. However, the study is limited by the specific location and characteristics of the institutions examined; therefore, future research is needed to test the "System-Driven Supervision" model across various educational

levels, regions, and organizational types—including through longitudinal approaches—to analyze the sustained impact of digitalization on the improvement of educational quality.

ACKNOWLEDGMENT

The authors sincerely thank Universitas Islam Negeri Kiai Haji Achmad Siddiq (UIN KHAS) Jember for the academic support, institutional facilities, and research environment provided throughout this study. The authors also thank MIN 3 Banyuwangi and MI NU Tegalsari Banyuwangi for their valuable contributions and cooperation during the research process.

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