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A Case Study of Integrating AI Literacy into School Leadership in Islamic Elementary Education Management at a Rural Madrasah

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Abstract

This study is grounded in the increasing demand for digital transformation in education, where the integration of artificial intelligence (AI) remains limited in rural Islamic primary schools due to infrastructural and human resource constraints. This gap highlights the need to explore how AI literacy can be enacted within school leadership practices in under-resourced madrasah contexts. This study aims to analyze the transformation of Islamic elementary education management through the integration of AI literacy into school leadership at MIN 3 Merangin, Bangko, Jambi. This research employed a qualitative approach using a single-case study design. Data were collected through in-depth interviews with the principal, three teachers, and two administrative staff, non-participant observation conducted over eight weeks, and document analysis. Purposive sampling was applied. Data analysis followed Miles and Huberman's interactive model, including data condensation, data display, and conclusion drawing and verification. The results indicate that the principal's AI literacy influences four dimensions of transformation: digital-based strategic planning, teacher capacity building for AI-assisted pedagogy, personalized Islamic education content development, and data-driven decision making. However, challenges such as limited internet infrastructure and resistance among senior teachers persist. The study concludes that AI literacy in school leadership functions as an adaptive and context-dependent competence rather than a fully institutionalized practice. These findings contribute to the development of a contextualized understanding of AI-informed leadership and offer practical implications for strengthening digital transformation in rural Madrasah settings.

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Introduction

The rapid advancement of artificial intelligence (AI) has become a defining feature of contemporary educational transformation, reshaping teaching, learning, and administrative practices across global contexts. Over the past decade, a growing body of research has highlighted the increasing role of AI in education, particularly in enabling personalized learning, adaptive instruction, and data-driven decision-making (Ashraf, 2024; Ng et al., 2021; Strielkowski et al., 2025). AI technologies are now embedded in learning management systems, intelligent tutoring platforms, and institutional management processes. However, the successful integration of AI in education is not determined solely by technological availability; it is fundamentally influenced by the capacity of school leadership to interpret, manage, and strategically implement these technologies (Deogaonkar, 2025; Fullan & Quinn, 2015; Kafa, 2025). School leaders play a decisive role in shaping the direction, pace, and sustainability of digital transformation. Without leaders who possess adequate AI literacy, even advanced technological infrastructures risk being underutilized or misaligned with pedagogical and institutional goals (Brewington, 2026).

The concept of AI literacy has emerged as a critical competency in the 21st century, extending beyond technical proficiency to encompass critical thinking, ethical awareness, and collaborative engagement with intelligent systems (Holmes et al., 2019; Long & Magerko, 2020). AI literacy enables individuals to evaluate algorithmic outputs, recognize bias, and utilize AI tools creatively and responsibly. Within educational leadership, this competency includes strategic visioning, data-informed decision-making, and the ability to cultivate organizational cultures that support responsible AI use (Meng et al., 2024; UNESCO, 2021; Zhang et al., 2024). The Technological Pedagogical Content Knowledge (TPACK) framework further highlights the necessity of integrating technological knowledge with pedagogical and content expertise (Mishra & Koehler, 2006). When extended to leadership, TPACK implies that school principals must not only understand instructional practices but also align technological innovation with educational values and institutional identity. For Islamic primary schools, this alignment is particularly complex, as leaders must balance technological advancement with the preservation of religious principles and moral frameworks that define Madrasah education (Syahbani, 2025; Zainuddin & Attaran, 2016).

Over the past ten years, studies on AI in education have largely focused on classroom-level applications and teacher competencies in well-resourced, urban settings (Holmes et al., 2019; Kim et al., 2026; Ng et al., 2021). By contrast, the intersection of AI literacy and school leadership, especially in rural Madrasah contexts, remains underexplored. In Indonesia, research on digital transformation in Madrasah has mostly addressed general technology use or administrative management, with limited attention to AI-specific leadership competencies (Nyale et al., 2026; Pedro et al., 2019). Although theoretical frameworks for AI literacy in leadership have been proposed (Long & Magerko, 2020; Meng et al., 2024), they tend to emphasize technical skills while overlooking contextual factors such as infrastructure poverty, religious values, and community expectations. This gap is particularly pronounced in rural areas, where structural constraints create distinct challenges.

In the Indonesian context, Madrasah especially those located in rural and resource-constrained areas face persistent structural challenges in digital transformation. These include limited infrastructure, unstable internet connectivity, restricted access to digital devices, and a lack of systematic professional development in digital and AI competencies (Nyale et al., 2026; Pedro et al., 2019). What distinguishes the Indonesian Madrasah context from Western or urban Asian settings is a unique combination of geographical isolation, limited government investment in digital infrastructure, and a dual curriculum system (general education plus Islamic studies). MIN 3 Merangin, a public Islamic primary school in Bangko, Jambi, exemplifies these conditions. The school serves approximately 280 students with only one computer lab containing five functioning devices, intermittent internet access, and no dedicated IT staff. Despite these constraints, preliminary observations indicate that the school principal has begun to explore generative AI tools, such as ChatGPT and Canva AI, to support lesson planning and administrative tasks. This paradox of “high aspiration, low infrastructure” makes MIN 3 Merangin an information-rich case for studying how AI literacy emerges through adaptive leadership rather than through top-down digital transformation policies. No prior study has documented AI leadership practices in a rural Indonesian Madrasah with this level of infrastructural limitation.

Given the emergent nature of this phenomenon, a single-case design was chosen over a comparative multi-madrasah approach. First, AI literacy in rural Madrasah leadership is still a nascent area of inquiry; an in-depth, context-sensitive exploration of one information-rich case allows for thicker description than a comparative design would permit (Yin, 2018). Second, Indonesian Madrasah vary considerably in infrastructure, funding, religious orientation, and geographic accessibility, making direct comparison premature without a prior typology of AI readiness. Third, the principal at MIN 3 Merangin represents a deviant case (Stake, 2013), where AI use occurs despite severe constraints. Understanding the mechanisms in this single case can generate transferable insights for other rural Madrasah, even without explicit comparison. Future comparative research can build on the findings of this study.

This study aims to address this gap by analyzing the transformation of Islamic elementary education management through the integration of AI literacy into school leadership at MIN 3 Merangin. The study is guided by three research questions: (1) How does the school principal demonstrate AI literacy in daily leadership practices? (2) What dimensions of school management are transformed through this integration? (3) What challenges and adaptive strategies emerge during this process? By answering these questions, this study contributes a contextualized, empirically grounded framework for AI-informed leadership in rural Madrasah settings. It also offers practical insights for school leaders, policymakers, and teacher educators seeking to foster AI literacy as a strategic competency while maintaining the Islamic identity of educational institutions.

The remainder of this article is organized as follows. The methods section outlines the qualitative case study design, including participant selection, data collection techniques, and analytical procedures. The results section presents the key findings related to the principal’s AI literacy, the transformation of management practices, and the challenges encountered. The discussion situates these findings within existing theoretical and

empirical literature and elaborates their implications for Islamic educational leadership. Finally, the conclusion summarizes the main contributions of the study, acknowledges its limitations, and proposes directions for future research.

Methods

This study employed a qualitative approach using an integrated single-case study design to explore the transformation of Islamic primary education management in the digital era through the integration of AI literacy into school leadership practices. A case study design was considered appropriate because the study aims to investigate a contemporary educational phenomenon within its real-life context, particularly where the boundaries between organizational transformation, leadership practices, and technological adaptation are closely intertwined and cannot be clearly distinguished (Creswell & Poth, 2016; Tisdell et al., 2025; Yin, 2018). A single-case embedded design was selected because, although school leadership constitutes the main case, the study examines several interrelated sub-units including teachers, administrative staff, and the school committee to provide a more comprehensive understanding of leadership transformation within the institution.

This study was conducted from August to September 2025 at MIN 3 Merangin, a public Islamic primary school located in Bangko, Jambi, Indonesia. The school was purposively selected as a critical case because it represents an early implementation of digital technology and AI-supported educational management in a resource-limited rural Islamic school context. Despite infrastructural limitations, such as unstable internet connectivity and limited access to digital devices, the institution has initiated the use of digital technologies and generative AI tools in school management and learning activities, making it a significant case for examining adaptive leadership transformation in the digital era (Tisdell et al., 2025; Yin, 2018).

Participants were selected using purposive sampling based on three criteria: (1) direct involvement in daily interactions with the school principal, (2) active participation in the planning, implementation, or evaluation of school programs, and (3) willingness to voluntarily participate in the study (Sugiyono, 2018). The participants consisted of the school principal as the main unit of analysis, three teachers representing lower-grade, upper-grade, and Islamic Religious Education classes, two administrative staff members, and one representative from the school committee. Participant recruitment continued until data saturation was reached, meaning that additional interviews no longer generated substantial new information (Fusch Ph D & Ness, 2015; Guest et al., 2020).

Data were collected through three complementary techniques: semi-structured interviews, non-participant observation, and document analysis. Semi-structured interviews were conducted using an interview guide developed from the AI literacy framework proposed by Long & Magerko, (2020), which includes competencies in recognizing, using, evaluating, and creating AI-generated content. These concepts functioned as sensitizing concepts to guide data collection and interpretation. In addition, the interview protocol incorporated dimensions of digital transformational leadership, including digital vision, a culture of innovation, professional development, and data-

driven decision-making (Müller et al., 2025). Each interview lasted between 45 and 60 minutes, was audio-recorded with participant consent, and transcribed verbatim for analysis.

Non-participant observation was conducted over eight consecutive weeks through the researchers physical presence in the school environment. During this period, the researcher observed staff coordination meetings, classroom supervision activities conducted by the principal, informal interactions between school leaders and teachers, and the practical use of generative AI technologies in educational and managerial activities. Field notes were written daily to document both descriptive events and reflective insights related to leadership practices and technological adaptation.

Document analysis was conducted by reviewing school work plans (RKS/M), teacher professional development programs, meeting minutes, and digital portfolios. These documents were analyzed to identify formal evidence of digital policy implementation and traces of AI integration in school management practices. To strengthen data credibility, source and method triangulation were systematically applied by comparing findings from interviews, observations, and document analysis (Denzin & Lincoln, 2011).

Data analysis followed the interactive model proposed by Miles (2014), which consists of three simultaneous processes: data condensation, data display, and conclusion drawing and verification. Analysis began with open coding to identify initial meaning units emerging from interview transcripts and field notes. These initial codes were then refined through axial coding to establish relationships among categories, such as the school leaders understanding of AI, transformations in strategic planning, infrastructural constraints, and adaptive leadership strategies. Finally, selective coding was used to integrate these categories into broader core themes related to the integration of AI literacy in school leadership transformation. The findings were organized into narrative descriptions and thematic matrices to facilitate the identification of patterns and relationships across categories. Conclusions were drawn iteratively throughout the research process and continuously verified through peer discussions and repeated examination of the raw data.

To ensure trustworthiness, this study adopted the criteria of credibility, transferability, dependability, and confirmability proposed by Lincoln (1980). Credibility was strengthened through source triangulation, method triangulation, member checking, and peer debriefing. Member checking was conducted by returning interview summaries to participants for validation and clarification. Transferability was supported through thick description, including detailed explanations of the school's geographical location, technological infrastructure, teacher and student demographics, and institutional culture, allowing readers to assess the applicability of the findings to similar educational contexts. Dependability was ensured through a systematic audit trail consisting of interview recordings, transcripts, field notes, original documents, coding frameworks, and researcher memos. Confirmability was maintained through a reflexive journal, in which the researcher documented personal assumptions, methodological decisions, and potential biases throughout the research process.

Ethical considerations were addressed prior to data collection. All participants provided informed consent and were informed about the voluntary nature of their participation, their right to withdraw at any time, and the confidentiality of their responses. To protect participant identity, all personal and sensitive institutional information was anonymized in the reporting process. The researcher explicitly communicated their role as an academic researcher without evaluative authority over school personnel to minimize power imbalances and encourage open participation (Karnieli-Miller et al., 2009).

Result and Discussion

Result

This section presents the findings from interviews, observations, and document analysis conducted at MIN 3 Merangin from August to September 2025. The findings are organized around the three main concerns of the study: how the principal demonstrates AI literacy, which dimensions of school management show transformation, and what challenges and adaptive strategies emerge in this process.

To provide an overview of AI literacy distribution across the school community, Table 1 presents a profile based on the total student population of 280.

Table 1. AI Literacy Profile of MIN 3 Merangin (Total Student: 280)

Category	Total Number	Number with AI Literacy	Percentage	Description
Students (Grades 1–6)	280	0	0%	No direct student use of AI tools; no AI access in classrooms
Teachers	12	2	16.7%	Two younger teachers (ages 28 and 31) demonstrated basic awareness and curiosity; no formal competence
Principal	1	1	100%	Self-directed learner; daily use of ChatGPT and Canva AI for administration and pedagogy
Administrative staff	2	0	0%	No AI use observed or reported
Total school community	295	3	1.0%	Only the principal and two teachers show any level of AI literacy

As shown in Table 1, AI literacy at MIN 3 Merangin is extremely limited and concentrated almost entirely in the principal. The following subsections elaborate on the qualitative findings behind this profile.

Demonstrations of AI Literacy in Daily Leadership

The principal at MIN 3 Merangin acquired the ability to use generative AI tools such as ChatGPT and Canva AI without any formal training or institutional support. Observations over the eight-week period showed that the principal relied on a personal laptop to access these tools, typically before teacher meetings or when preparing official documents. When

asked about the learning process, the principal explained that YouTube tutorials and trial-and-error experimentation were the only available pathways, as the school had never offered any digital training related to artificial intelligence. This pattern of autonomous competency development was confirmed by document analysis of the school's annual training plan, which contained no mention of AI or digital literacy programs.

In daily practice, the principal used AI for two broad types of tasks. For administrative work, ChatGPT helped draft official correspondence, meeting minutes, and school reports. On one observed occasion, a monthly report to the Ministry of Religious Affairs was first generated by ChatGPT and then edited by the principal. A comparison with previous years manually written reports showed noticeable differences in sentence structure and formatting, with the AI-assisted draft using more formulaic transitions and bullet-point summaries. For pedagogical tasks, the principal used ChatGPT to develop Islamic education materials, including stories with moral lessons, quiz questions, and activity plans. A Canva AI-generated presentation on prayer was shared during a teacher meeting, where the principal demonstrated how teachers could modify the visuals.

What distinguished the principal's AI literacy from mere tool use was a consistent practice of verification. Rather than accepting AI outputs as authoritative, the principal cross-checked generated content against the Qur'an and approved textbooks. This habit became evident through document analysis of lesson plans, where handwritten corrections appeared next to AI-generated text. In one instance, an AI-generated quiz item about prayer contained a minor inaccuracy regarding the number of obligatory *rak'ahs*; the principal corrected the figure and added a marginal note directing attention to the relevant textbook page. In another case, an AI-generated story about honesty included a non-Islamic proverb, which the principal crossed out and replaced with a Qur'anic verse. This practice of religious validation suggests that AI literacy in Islamic educational contexts requires not only technical and pedagogical knowledge but also a capacity to evaluate content against theological standards, an extension of the TPACK framework (Mishra & Koehler, 2006).

Dimensions of School Management that show Transformation

Four dimensions of school management showed evidence of change: strategic planning, teacher capacity building, Islamic content development, and data-driven decision-making. However, document analysis consistently indicated that none of these changes had been formally institutionalized.

The most visible transformation occurred in the preparation of the school's strategic planning documents, including program descriptions and activity plans. Previously, the principal prepared these documents by manually copying and modifying previous years versions, a process that consumed most of the planning meeting time. During the research period, the principal used ChatGPT to generate initial drafts before meetings began. Observation of one planning meeting recorded that the principal arrived with a complete draft of a program section. Teachers spent approximately forty-five minutes discussing and refining the content, whereas the principal recalled that previous meetings required over two hours simply to create a draft from scratch. Teachers interviewed confirmed that this new approach allowed them to focus on substance rather than formatting.

Nevertheless, analysis of the final approved planning documents showed no explicit mention of artificial intelligence; the term “digital literacy” appeared once without operational definition. Thus, the transformation remains at the level of individual leadership practice rather than institutionalized strategy.

The principal’s influence on teacher capacity was informal and uneven. Instead of organizing training sessions, the principal shared AI-generated materials and tutorial links through the school’s WhatsApp group. A review of group messages from August to September 2025 identified twelve such shares, including links to short videos on using Canva AI and sample prompts for ChatGPT. During break times, the principal was observed demonstrating AI tools to two younger teachers, who responded with curiosity and asked practical questions. However, senior teachers expressed hesitation. One teacher with twenty-five years of experience stated a preference for familiar methods, while another raised concerns about religious accountability, worrying that an AI-generated error might unintentionally mislead students. No formal professional development records related to AI were found in the school’s archive, confirming the absence of structured capacity-building. The diffusion of AI literacy therefore proceeds slowly, dependent on peer modeling and individual initiative rather than systematic training.

In the domain of Islamic content development, the principal used AI to produce differentiated materials for different grade levels. Document analysis of teaching files revealed AI-generated stories for second graders, quiz questions about the names of Allah for fourth graders, and case studies on ethical dilemmas for sixth graders. The principal explained that ChatGPT could adjust language complexity and content depth according to grade level, a task that would be too time-consuming to perform manually for every lesson. Observation of a third-grade lesson on patience showed the principal using an AI-generated story; students participated actively in the subsequent discussion, and the principal noted afterward that preparation time had been reduced from roughly two hours to under one hour. Notably, the same document analysis that revealed AI-generated content also showed handwritten annotations verifying Islamic references, confirming that the principal continued the validation practice described earlier.

The fourth dimension, data-driven decision-making, showed the least transformation. The principal claimed to use ChatGPT for analyzing student exam results, but repeated observations from August to September 2025 produced no instance of this happening. A review of student assessment records revealed only handwritten grade lists with no accompanying AI-generated summaries or statistical breakdowns. Decisions about which students needed remedial classes were based on a simple threshold of scores below seventy, a method unchanged from previous years. When asked to demonstrate the process, the principal explained that unstable internet connectivity made regular data analysis impractical. This gap suggests that the aspiration to use AI for decision-making has not yet translated into routine practice, constrained by both infrastructure and the absence of an analytical culture within the school.

Challenges and Adaptive Strategies

Three categories of challenges were identified: structural constraints related to infrastructure, cultural resistance among teachers, and the complete absence of institutional support. In response, the principal developed practical adaptive strategies that made partial integration possible despite these barriers.

The most persistent structural constraint was internet connectivity. During August and September 2025, the school's internet connection was unavailable on 18 out of 25 school days during the observation period. The school possesses one computer lab with five functioning devices for approximately 280 students, and there is no dedicated information technology staff. Facing these limitations, the principal adopted an offline preparation strategy. AI tools were accessed at home using personal internet connection, and generated materials were saved to a USB drive or laptop for use at school. On several observed occasions, the principal arrived carrying a USB drive containing materials prepared the previous evening. Distribution of these materials occurred through offline channels as well, including Bluetooth file transfer, USB sharing, and printed handouts for the two teachers who did not own smartphones. While this strategy succeeded in making AI use possible, the principal acknowledged that it required extra work and was not sustainable without systemic changes.

Cultural resistance emerged particularly among senior teachers. Interviews revealed two distinct sources of hesitation: general anxiety about technology and specific fear of religious errors. One senior teacher worried that a mistake made using AI might constitute a sin if incorrect religious content reached students. Rather than mandating AI use, the principal adopted a gradual approach. Demonstrations were given during informal moments, such as breaks or after meetings, without any requirement for teachers to participate. For interested teachers, the principal offered short one-on-one coaching sessions lasting ten to fifteen minutes after school. Teachers were encouraged to start with very small tasks, such as generating a single quiz question. Over the two-month research period, at least one previously resistant senior teacher was observed asking the principal for help generating a story for moral education, suggesting that slow, low-pressure exposure can gradually reduce resistance.

The most fundamental challenge was the absence of institutional support. No school policy, district guideline, or ministry circular mentioned AI literacy for principals or teachers. No budget line item supported digital innovation. The principal received no additional compensation or recognition for the extra work of learning and implementing AI tools. Consequently, the entire integration effort rested on one individual. The principal explicitly acknowledged that illness or transfer would likely end the practice, as no other staff member possessed similar skills. This fragility was confirmed by document analysis, which showed no standard operating procedures, training manuals, or knowledge transfer mechanisms related to AI. While the principal's individual initiative successfully demonstrated that AI integration is possible in a resource-limited rural madrasah, the lack of systemic support means that this integration remains partial, fragile, and unlikely to survive beyond the current principal's tenure. Table 2 quantitatively illustrates this concentration: out of 295 members of the school community, only three (1.0%) have any AI literacy, and only one (the principal) has functional competence.

Table 2. Summary of Findings by Research Question

Research Question	Key Findings	Primary Evidence
RQ1: How does the principal demonstrate AI literacy?	Self-directed learning via YouTube; daily AI use for administration and pedagogy; systematic validation against Qur'an and textbooks	Observation of laptop use; document comparison of reports; handwritten corrections on lesson plans
RQ2: What management dimensions are transformed?	Strategic planning (AI-assisted drafts, meeting time reduced); teacher capacity (informal WhatsApp sharing, mixed responses); Islamic content (differentiated materials for grades 2,4,6); decision-making (aspirational, not operational)	RKS meeting observation; WhatsApp logs; lesson plan documents; absence of AI analysis in student records
RQ3: What challenges and adaptive strategies emerge?	Challenges: internet unavailable most days, teacher fear of mistakes, no institutional policy; Strategies: offline preparation (USB/home), gradual exposure, one-on-one coaching, low-stakes entry tasks	Internet logs; teacher interview statements; observation of coaching sessions

Discussion

The purpose of this study was to analyze how AI literacy is integrated into school leadership at MIN 3 Merangin, a rural Islamic primary school in Indonesia, and to identify what dimensions of school management are transformed, as well as what challenges and adaptive strategies emerge. The findings from the Result section are discussed here in relation to existing literature, with a focus on comparing similarities and contradictions with previous studies. Each discussion point is grounded in specific evidence from the research conducted from August to September 2025.

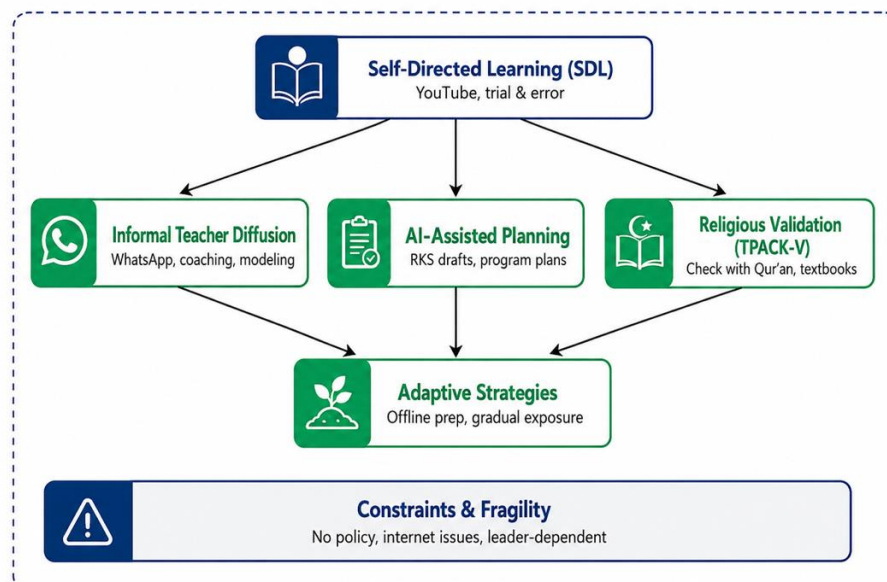


Figure 1. Conceptual Model of AI Literacy as Adaptive Leadership in a Rural Madrasah Context.

Self-Directed AI Literacy as an Emergent Competence

The Result section showed that the principal acquired AI literacy solely through self-directed learning, using YouTube tutorials and trial-and-error experimentation, without any formal training or institutional support. This finding is consistent with (Holmes et al., 2019), who argued that AI literacy can emerge through individual initiative in contexts where structured professional learning is unavailable. However, this pattern differs from assumptions in the broader educational leadership literature, which often presupposes that digital competencies are developed through systematic professional development programs (Fullan & Quinn, 2015). In MIN 3 Merangin, document analysis confirmed that the school's annual training plan contained no AI-related programs, and the principal explicitly stated that no formal support existed. Thus, while the finding supports the notion of emergent AI literacy, it also highlights that in rural madrasahs, such literacy is not a planned competency but an adaptive response to local constraints.

AI-Assisted Planning: Early-Stage Transformation without Institutionalization- Informal Diffusion of AI

The finding that the principal used ChatGPT to draft strategic planning documents (e.g., program descriptions and activity plans) and that meeting time was reduced from over two hours to approximately forty-five minutes demonstrates that AI can enhance procedural efficiency even in resource-limited settings. This aligns with Fullan & Quinn, (2015), who emphasized that leadership-driven change can initiate digital transformation without systemic support. However, unlike models of systemic integration that assume institutionalization follows individual innovation, the transformation at MIN 3 Merangin remained at the individual level. Document analysis of the final approved planning documents showed no explicit mention of AI, and the term "digital literacy" appeared only once without operational definition. Therefore, this finding supports early-stage digital leadership models but reveals that institutionalization does not automatically follow individual initiative. It confirms that contextual factor such as absence of policy and infrastructure – can prevent the scaling of innovation.

Informal Diffusion of AI Literacy to Teachers: Leadership Modeling as a Mechanism

The Result section revealed that the principal influenced teachers through informal means: sharing AI-generated materials and tutorial links on WhatsApp (twelve shares observed) and demonstrating tools during break times. Teachers' responses were mixed; younger teachers showed curiosity, while senior teachers expressed fear of making mistakes, including religious errors. This pattern supports George (1999) concept of leadership modeling, where leader behavior shapes organizational culture without formal interventions. However, it also shows that modeling alone is insufficient to overcome deep-seated resistance, especially when religious accountability is perceived as at stake. No formal professional development records were found, and a senior teacher explicitly stated a preference for familiar methods. This finding suggests that while informal diffusion can raise awareness, it cannot replace structured capacity-building, a gap that has been noted in previous research on technology adoption in traditional educational settings (Pedro et al., 2019).

Ethical and Religious Validation: Extending the TPACK Framework

A distinctive finding was the principal's consistent practice of verifying AI-generated content against the Qur'an and approved textbooks. Handwritten corrections on lesson plans such as correcting a hadith attribution and replacing a non-Islamic proverb with a Qur'anic verse demonstrated a value-based validation process. This finding extends the TPACK framework (Mishra & Koehler, 2006), which integrates technological, pedagogical, and content knowledge. In Islamic educational contexts, a fourth dimension religious validation becomes necessary. No previous study on AI literacy in education has explicitly incorporated this dimension. Therefore, this study proposes that TPACK for Islamic schools should be reconceptualized as TPACK-V (Technological, Pedagogical, Content, and Value-based Validation). This contribution fills a gap in the literature on AI integration in religious education.

Limited Data-Driven Decision-Making: The Aspirational Gap

The Result section showed that although the principal claimed to use ChatGPT for analyzing student exam results, no evidence of such use was found during observations or document analysis. Student records remained handwritten, and decisions about remedial classes were based on a simple threshold of scores below seventy. The principal admitted that unstable internet connectivity made regular data analysis impractical. This finding is consistent with Trushkina et al., (2020), who argued that digital transformation requires not only technological tools but also organizational routines and an analytical culture. The absence of such culture at MIN 3 Merangin means that AI remains underutilized for strategic decision-making. This finding contrasts with more optimistic accounts of AI in education that assume tool availability automatically leads to data-driven practices (Holmes et al., 2019). Thus, the study confirms that infrastructure and analytical capacity are prerequisites for data-driven leadership, which are not yet present in this rural madrasah.

Adaptive Strategies in Response to Structural and Cultural Constraints

The findings identified three major challenges: frequent internet disconnection (unavailable on most days), teacher fear of religious errors, and no institutional policy. In response, the principal developed adaptive strategies: offline preparation (using USB drives from home), gradual exposure, one-on-one coaching, and low-stakes entry tasks. These strategies align with the concept of adaptive leadership in resource-constrained settings (Stake, 2013). They also resonate with Nyale et al., (2026), who documented similar coping mechanisms in rural Indonesian schools. However, this finding challenges the assumption that digital transformation requires top-down policy and large-scale investment. The principal's approach using personal internet at night, sharing materials via Bluetooth, and spending ten to fifteen minutes coaching interested teachers after school demonstrates that innovation can be negotiated within severe constraints. Nevertheless, the principal also acknowledged that illness or transfer would likely end the practice, as no other staff member possessed similar skills. This fragility supports the argument by Nyale et al., (2026) that without systemic support, leader-dependent transformation is unsustainable.

Table 3. Comparison of Findings with Previous Studies

Finding from This Study	Related to (Similar)	Extends or Differs From
Self-directed AI literacy	Holmes et al. (2019): emergent AI literacy	Differs from assumptions that digital competencies require formal training (Fullan & Quinn, 2015)
AI-assisted planning (early-stage, not institutionalized)	Fullan & Quinn (2015): leadership-driven change	Extends by showing that institutionalization does not automatically follow individual initiative
Informal teacher diffusion via modeling	George et al. (1999): leadership modeling	Extends by revealing that modeling alone is insufficient without structured capacity-building (Pedro et al., 2019)
Religious validation of AI content	TPACK (Mishra & Koehler, 2006)	Extends TPACK by adding value-based/religious validation (proposes TPACK-V)
Limited data-driven decision-making	Trushkina et al. (2020): need for analytical culture	Differs from optimistic accounts assuming tool availability leads to data-driven practices (Holmes et al., 2019)
Adaptive strategies (offline, coaching)	Stake (2013): adaptive leadership; Nyale et al. (2026): rural coping mechanisms	Extends by demonstrating fragility of leader-dependent transformation without systemic support

Conclusion

Based on the findings, this study answers the research questions in three main ways. The principal demonstrates AI literacy through self-directed learning and practical use of generative AI tools such as ChatGPT and Canva AI to support lesson planning, administrative tasks, and communication processes, indicating that AI literacy in this context is developed informally and enacted through everyday leadership practices. Additionally, the integration of AI literacy has contributed to several dimensions of school management transformation, including digital-based strategic planning, differentiated Islamic learning content, and increased teacher awareness through informal diffusion, although these transformations remain at an early stage and are not yet institutionalized. The study also identifies key challenges such as limited infrastructure, lack of formal training, and teacher resistance, alongside adaptive strategies like gradual implementation and informal knowledge sharing. These findings suggest that AI literacy functions as an adaptive but individual-based leadership practice rather than a systemic organizational competence. Therefore, strengthening institutional support, developing structured AI literacy programs for school leaders, and fostering an analytical culture are essential to ensure more sustainable and scalable digital transformation in rural madrasah contexts.

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