



Artificial Intelligence and the Transformation of Islamic Knowledge Transmission in Indonesian Pesantren

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ABSTRACT

The rapid development of artificial intelligence (AI) and digital learning technologies has transformed the transmission of Islamic knowledge in Indonesian pesantren. This study examines how AI reshapes educational practices, religious authority, and knowledge dissemination within traditional Islamic boarding schools. Using a normative and conceptual approach combined with digital Islamic studies methodology, the research analyzes academic literature, policy documents, and case studies of pesantren undergoing digital transformation. The findings show that AI enhances accessibility, learning efficiency, and the dissemination of Islamic knowledge beyond conventional spatial boundaries, while fostering hybrid learning environments where digital systems coexist with teacher-centered authority and sanad traditions. Nevertheless, the integration of AI also raises significant concerns regarding the authenticity of religious knowledge, the weakening of direct teacher-student interaction, algorithmic bias, and the preservation of classical Islamic pedagogical traditions. The study concludes that AI adoption in pesantren requires ethical and pedagogical frameworks grounded in Islamic educational values, digital literacy, and institutional supervision to ensure that technological innovation complements rather than replaces traditional religious authority. This research contributes to contemporary discussions on digital Islam, Islamic education, and the governance of AI in religious institutions

ABSTRAK

Perkembangan pesat kecerdasan buatan (AI) dan teknologi pembelajaran digital telah mengubah transmisi pengetahuan Islam di pesantren Indonesia. Penelitian ini mengkaji bagaimana AI membentuk ulang praktik pendidikan, otoritas keagamaan, dan penyebaran pengetahuan dalam lembaga pendidikan Islam tradisional. Menggunakan pendekatan normatif dan konseptual yang dipadukan dengan metodologi studi Islam digital, penelitian ini menganalisis literatur akademik, dokumen kebijakan, dan studi kasus pesantren yang mengalami transformasi digital. Temuan menunjukkan bahwa AI meningkatkan aksesibilitas, efisiensi pembelajaran, serta penyebaran pengetahuan Islam melampaui batas ruang konvensional, sekaligus menciptakan lingkungan pembelajaran hibrida di mana sistem digital berdampingan dengan otoritas guru dan tradisi sanad. Namun demikian, integrasi AI juga menimbulkan tantangan signifikan terkait autentisitas pengetahuan agama, melemahnya interaksi langsung guru dan murid, bias algoritma, serta pelestarian tradisi pedagogis Islam klasik. Penelitian ini menyimpulkan bahwa adopsi AI di pesantren memerlukan kerangka etis dan pedagogis yang berlandaskan nilai-nilai pendidikan Islam, literasi digital, dan pengawasan kelembagaan agar inovasi teknologi mendukung, bukan menggantikan, otoritas keagamaan tradisional. Penelitian ini berkontribusi pada diskursus kontemporer mengenai Islam digital, pendidikan Islam, dan tata kelola AI dalam institusi keagamaan.



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1. INTRODUCTION

The landscape of Islamic education worldwide is undergoing a fundamental transformation driven by the rapid penetration of artificial intelligence into educational systems. Indonesian pesantren, as indigenous religious educational institutions with deep historical roots spanning over six centuries,

now face an unprecedented challenge in navigating this digital transformation while preserving their distinctive identity and pedagogical traditions (Sofi et al., 2025). The emergence of AI-powered educational tools, including adaptive learning platforms, intelligent tutoring systems, and digital Islamic content repositories, has disrupted the traditional modes of religious knowledge transmission that have characterized pesantren education for generations. This change represents both an emergency requiring immediate institutional response and a potential solution to expanding access to quality Islamic education across the archipelago. The controversy lies in whether AI can adequately replace or complement the spiritual, moral, and relational dimensions of pesantren pedagogy that have historically been transmitted through direct human interaction between kyai (religious scholars) and santri (students) (Studi et al., 2025).

The urgency of examining this transformation stems from multiple interconnected factors that demand scholarly attention. Indonesia hosts the world's largest Muslim population and maintains more than 25,000 pesantren institutions that educate millions of students annually (Hussin et al., 2017). The COVID-19 pandemic accelerated the adoption of digital technologies in these institutions, revealing both opportunities and critical gaps in digital readiness. Research indicates that Islamic educational institutions face significant challenges in infrastructure limitations, insufficient teacher training, and ethical considerations regarding technology implementation (Pratama & Muhammad, 2025). Furthermore, the integration of AI in education globally has raised concerns about algorithmic bias, data privacy violations, and the potential marginalization of traditional scholarly authority (Farhan et al., 2026). For pesantren specifically, the stakes include preserving the authenticity of religious knowledge, maintaining the sacred chain of transmission (sanad), and ensuring that technological innovation does not erode the spiritual and moral formation central to Islamic education.

The global academic discourse on AI in education has expanded substantially, with bibliometric analyses indicating a marked increase in publications from 2022 to 2025, particularly focusing on Islamic educational contexts (Azzukhruf, 2026). International scholarship has examined AI integration in various educational settings, addressing themes such as personalized learning, administrative efficiency, and ethical frameworks for responsible technology adoption (Mursalova, 2026). Studies have explored how digital media affects religious authority and the shift from embodied knowledge traditionally acquired through direct interaction with scholars to disembodied knowledge facilitated by digital platforms (Abusharif, 2024). However, a significant gap exists in understanding how AI specifically interacts with Islamic epistemological traditions and traditional pedagogical institutions like pesantren. Limited attention has been given to the ethical alignment of AI with Islamic values, particularly regarding the preservation of sanad-based learning and the role of human spiritual mentorship (Azzukhruf, 2026).

1.1 Problem Formulation and Research Gap

Within the Indonesian context, scholarly attention to AI integration in Islamic education has grown considerably. Studies have examined digital transformation in madrasah education in East Java, revealing that institutions are implementing Learning Management Systems and flipped classroom models while attempting to preserve Islamic values through ethical content filtering (Wedi et al., 2025). Research on pesantren specifically has documented the adoption of online learning platforms, digital Quran applications, and Maktabah Syamilah for accessing classical texts (Abidin & Fadlullah, 2025). However, existing literature predominantly employs descriptive approaches focusing on implementation processes rather than critically examining the epistemological and pedagogical implications of AI adoption. Furthermore, while studies acknowledge challenges such as limited infrastructure and teacher digital literacy, comprehensive frameworks for integrating AI with pesantren values and traditions remain underexplored (Lestari et al., 2025). There is a notable absence of studies that systematically analyze how AI affects the fundamental elements of pesantren education: the kyai's authority, the santri's spiritual formation, and the transmission of tacit knowledge that cannot be codified in digital systems.

Based on the identified gaps in existing scholarship, this study addresses the following research problems: How does artificial intelligence transform the transmission of Islamic knowledge in

Indonesian pesantren? What factors facilitate and inhibit the successful integration of AI in pesantren educational practices? What ethical and pedagogical frameworks can ensure that AI adoption supports rather than undermines traditional Islamic learning authority? These questions guide the analysis toward understanding both the descriptive realities of AI implementation and the normative considerations necessary for responsible technology integration. The study recognizes that pesantren institutions vary significantly in their orientation toward modernity, ranging from salafiyah (traditional) pesantren that maintain classical methods to modern pesantren that have embraced comprehensive curricular reforms (Arifin, 2022).

1.2 Theoretical Framework

This study draws upon multiple theoretical perspectives to analyze the phenomenon under investigation. Rogers' Diffusion of Innovations Theory provides a framework for understanding how AI technologies spread within pesantren institutions and the factors influencing adoption patterns (Wedi et al., 2025). The concept of maqasid al-shariah (objectives of Islamic law) offers an Islamic ethical lens for evaluating AI implementation, emphasizing the protection of religion (hifz al-din), intellect (hifz al-aql), and the broader principles of justice and public benefit (Habib, 2025). Additionally, the study engages with digital Islamic studies scholarship that examines the transformation of religious authority in digital contexts, particularly the tension between embodied knowledge transmission and disembodied digital learning (Abusharif, 2024). The theoretical framework recognizes that pesantren education is grounded in relational pedagogy where ta'dzim (reverence) toward kyai functions as a socio-pedagogical mechanism for knowledge transmission, character formation, and value internalization (Maryam, 2023).

This study aims to achieve three primary objectives. First, it seeks to describe the current landscape of AI adoption in Indonesian pesantren, documenting the types of technologies being implemented and the contexts of their use. Second, it analyzes the factors that enable or constrain successful AI integration, including institutional leadership, infrastructure, digital literacy, and cultural-religious considerations. Third, it develops a normative framework that harmonizes AI adoption with Islamic educational values, proposing guidelines for ethical and pedagogically sound technology integration that preserves the distinctive contributions of pesantren education while leveraging technological benefits for expanded access and improved learning outcomes.

1.3 Research Contribution

This research contributes to contemporary scholarship in several significant ways. Theoretically, it extends the application of digital Islamic studies and innovation diffusion theory to the specific context of pesantren institutions, an area that remains relatively underexplored (Abidin & Fadlullah, 2025). Practically, it provides empirical insights and strategic recommendations for pesantren administrators, educators, and policymakers seeking to navigate digital transformation responsibly. The study proposes an integrative framework that positions AI as a supportive tool (wasilah) rather than a replacement for human educators who serve as murabbi (character formers) and spiritual guides (Haq & Adiningsih, 2025). By examining both opportunities and challenges, this research offers a balanced perspective that avoids technological determinism while acknowledging the transformative potential of AI for Islamic education. The findings inform institutional policies, teacher training programs, and curriculum development initiatives aimed at preparing pesantren for the Society 5.0 era while maintaining their foundational religious and moral mission.

2. LITERATUR REVIEW

The academic literature on technology and artificial intelligence in Islamic education has experienced significant growth over the past five years. Bibliometric analysis of Scopus-indexed publications reveals a shift from basic digital adoption toward more advanced technological applications, with Indonesia and Malaysia emerging as the most prolific contributors to this research area (Azzukhruf, 2026). Early studies during the pandemic period focused primarily on e-learning

effectiveness and the challenges of transitioning traditional face-to-face instruction to online formats. More recent literature has shifted attention to AI integration, institutional management in pesantren, and ethical considerations surrounding technology use in religious education. Despite this growth, studies on general e-learning effectiveness appear saturated, while limited attention has been directed toward the ethical alignment of AI with Islamic values and the distinctive pedagogical traditions of pesantren (Azzukhruf, 2026). Research approaches have predominantly been qualitative, employing case studies and literature reviews, with fewer studies utilizing mixed methods or longitudinal designs that could capture the long-term impacts of AI integration on student learning and spiritual development.

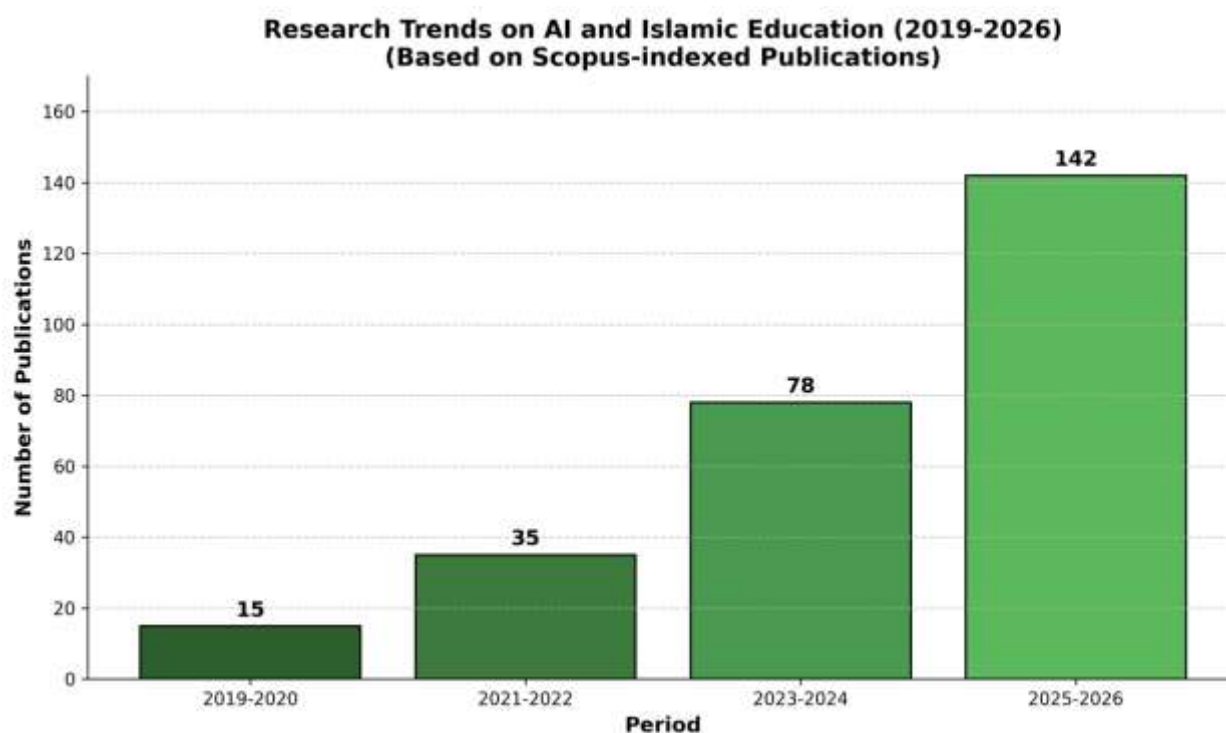


Figure 1. Research trends on AI and Islamic Education (source: Data processed by the authors)

A substantial body of literature examines the factors that influence AI adoption in Islamic educational institutions. Studies consistently (figure.1) identify infrastructure limitations as a primary barrier, including inadequate internet connectivity and insufficient access to AI hardware and software (Efrizal et al., 2024). Teacher readiness emerges as another critical factor, with research indicating that many educators lack the digital competencies necessary to effectively integrate AI tools into their teaching practices. One study found that classroom practice in Islamic Religious Education remains concentrated at lower levels of technology integration, with limited movement toward transformative uses that fundamentally redesign learning experiences (Putra et al., 2025). Institutional leadership plays a decisive role, as the commitment of kyai and pesantren administrators significantly influences the extent and manner of technology adoption (Abidin & Fadlullah, 2025). The study of Madrasah Aliyah in Karawang found that while AI tools have enhanced instructional efficiency and learner engagement, concerns persist regarding data privacy, teacher competency, and alignment with Islamic ethical values (Hermawan et al., 2025). Financial constraints also limit AI adoption, particularly in traditional pesantren that rely on community funding rather than state support (Studi et al., 2025).

The literature documents various processes through which AI technologies are being integrated into Islamic educational settings. Studies reveal that pesantren have adopted AI through multiple channels: the use of online learning platforms, digital Quran and Maktabah Syamilah applications, digital information and administration systems, and social media for promotional and da'wah purposes

(Abidin & Fadlullah, 2025). In madrasah contexts, AI-driven initiatives include adaptive learning platforms that personalize delivery of Islamic subjects, Natural Language Processing tools for students with disabilities, and AI-powered learning analytics to identify students at risk of learning gaps (Royhatudin et al., 2026). The digital transformation model observed in Madrasah Aliyah institutions manifests in two key aspects: institutional strategy involving digital infrastructure development and stakeholder collaboration, and pedagogical systems integrating Learning Management Systems and flipped classroom models (Wedi et al., 2025). Research also documents the development of AI-based teaching modules that emphasize three foundations: technology-spirituality synergy, moderation principles in technological adoption, and contextualization of religious materials in digital landscapes (Zuhriyeh et al., 2025). These processes occur within a framework that seeks to balance innovation with the preservation of traditional values.

2.1 Impact of AI on Islamic Education

The impact of AI on Islamic education is multifaceted, encompassing both positive outcomes and concerning challenges. On the positive side, research demonstrates that AI enhances learning accessibility, instructional efficiency, and administrative effectiveness (Rahmawati et al., 2026). AI enables personalized learning experiences, rapid feedback mechanisms, and interactive learning aligned with the characteristics of digital-native students (Zain et al., 2025). Studies show that AI tools such as ChatGPT and digital Quran applications have contributed to increased student understanding, motivation, and critical engagement in Islamic Religious Education (Hanifaa & As'ad, 2025). The integration of AI in da'wah (Islamic preaching) has expanded reach and enabled more intense interaction between preachers and audiences (Hidayatullah et al., 2024). However, significant concerns have emerged regarding the potential erosion of direct scholarly interaction, with research warning that digital learning environments challenge the depth of interpersonal transmission central to pesantren pedagogy (Munawar & Endang, 2026). The shift from embodied to disembodied knowledge pathways raises fundamental questions about the authenticity of religious knowledge when mediated through algorithmic systems (Abusharif, 2024). Studies identify risks including algorithmic bias that may reinforce social discrimination, privacy violations, unclear accountability in autonomous AI systems, and the potential marginalization of certain student groups (Habib, 2025).

2.2 Critical Evaluation of Previous Studies and Research Direction

While the existing literature provides valuable insights into AI integration in Islamic education, several limitations warrant critical evaluation. First, most studies employ descriptive qualitative approaches that document implementation processes without deeply engaging the epistemological implications of AI for Islamic knowledge traditions. Few studies rigorously examine how AI affects the sanad (chain of knowledge transmission) that authenticates religious knowledge or analyze the theological implications of algorithmically mediated religious learning. Second, the literature tends to treat pesantren as a homogeneous category, overlooking the significant diversity among salafiyah, modern, and hybrid institutions in their orientations toward technology (Sofi et al., 2025). Third, there is insufficient attention to the long-term impacts of AI integration on student spiritual development and character formation, which represent core objectives of pesantren education. Fourth, while studies acknowledge ethical challenges, few offer comprehensive frameworks grounded in Islamic jurisprudence that could guide practical implementation decisions. Fifth, the literature predominantly focuses on higher education and madrasah contexts, with less attention to pesantren institutions and their unique pedagogical characteristics. These gaps necessitate research that moves beyond description to develop normative frameworks aligned with Islamic educational philosophy.

This study addresses the identified gaps by proposing an integrated conceptual framework that harmonizes AI adoption with the distinctive values and pedagogical traditions of pesantren education. The novelty lies in positioning AI within the broader context of Islamic epistemology and maqasid al-shariah, offering a principled approach to technology integration that transcends technical considerations. The research direction emphasizes the need to reconceptualize the role of technology in pesantren not as a replacement for human educators but as a *wasilah* (instrumental means) that supports

the fundamental mission of forming morally and spiritually developed Muslims (Andrini et al., 2025). This approach recognizes that certain dimensions of Islamic education, particularly the transmission of tacit knowledge, spiritual exemplarity (*uswah*), and the formation of *akhlakul karimah* (noble character), require human mentorship that cannot be replicated by algorithmic systems (Mahfud & Maarif, 2026). The study contributes a framework for ethical AI governance in pesantren that prioritizes transparency, accountability, and alignment with Islamic values while acknowledging the legitimate benefits of technology for expanding access and improving learning efficiency.

3. METHODS

3.1 Research Design

This study employs a normative and conceptual research design combined with digital Islamic studies methodology. The normative approach examines how AI integration in pesantren education ought to proceed based on Islamic educational principles and values, while the conceptual analysis synthesizes existing literature to develop theoretical frameworks (Rahmawati et al., 2026). This design is appropriate given the study's objectives of both understanding the current landscape of AI adoption and proposing normative guidelines for responsible integration. The research follows a qualitative paradigm that prioritizes depth of understanding and interpretive analysis over statistical generalization. The choice of this design reflects the nature of the research questions, which require engagement with philosophical, theological, and pedagogical considerations that extend beyond empirical description. The methodology draws upon established approaches in Islamic education research that integrate textual analysis with critical examination of contemporary practices.

3.2 Unit of Analysis

The primary unit of analysis is the phenomenon of AI integration in Indonesian pesantren education, examined at multiple levels. At the institutional level, the analysis considers how pesantren as organizations respond to technological change and make decisions about AI adoption. At the pedagogical level, the analysis examines the teaching-learning processes that incorporate AI tools and the implications for knowledge transmission. At the conceptual level, the analysis engages with theoretical frameworks and ethical principles that inform responsible AI integration. The study focuses specifically on pesantren institutions rather than madrasah or other Islamic educational settings, recognizing the distinctive characteristics of pesantren including the central authority of the *kyai*, the residential nature of *santri* education, the emphasis on classical texts (*kitab kuning*), and the formation of religious character through immersive community life (Azizah et al., 2023).

3.3 Data Sources

The study draws upon both primary and secondary data sources as detailed in the following table:

Data Category	Source Type	Description
Primary Sources	Academic Literature	Peer-reviewed journal articles indexed in Scopus, Web of Science, and accredited national journals (SINTA) published 2019-2026
Primary Sources	Policy Documents	Government regulations including Law No. 18 of 2019 concerning Pesantren, Ministry of Religious Affairs circulars on educational technology
Primary Sources	Institutional Records	Published case studies and institutional reports from pesantren undergoing digital transformation

Data Category	Source Type	Description
Secondary Sources	Classical Islamic Texts	Works on Islamic pedagogy including Ta'lim al-Muta'allim, Ihya Ulum al-Din, and contemporary Islamic educational philosophy
Secondary Sources	International Reports	UNESCO recommendations on AI in education, policy frameworks on educational technology ethics
Secondary Sources	Academic Books	Scholarly monographs on pesantren education, digital transformation, and AI ethics

The selection criteria prioritized recent publications (2022-2026) to capture the most current developments, though foundational works on pesantren education and Islamic pedagogy from earlier periods were included for theoretical grounding. Sources were selected based on relevance to the research questions, methodological rigor, and contribution to understanding the intersection of AI and Islamic education.

3.4 Data Collection Techniques

Data collection proceeded through systematic literature review following established protocols. Initial searches were conducted using keywords including "artificial intelligence," "Islamic education," "pesantren," "digital transformation," and related terms in both English and Bahasa Indonesia. Database searches targeted Scopus, Google Scholar, and Indonesian academic repositories. The screening process involved reviewing titles and abstracts for relevance, followed by full-text analysis of selected sources. Additional sources were identified through citation tracking and expert recommendations. Document analysis of policy materials followed a similar protocol, focusing on official government regulations and institutional guidelines relevant to AI integration in religious education. The data collection process yielded a corpus of literature that was then organized thematically for analysis. Following the approach of thematic content analysis, key passages were extracted and coded according to emerging themes related to the research questions (Hermawan et al., 2025).'

Table 2: Summary of Data Sources for This Study

Category	Type of Source	Number	Publication Period
Academic Journals	Scopus/Web of Science	22	2022-2026
Academic Journals	SINTA Accredited	8	2022-2026
Government Documents	Regulations/Policies	3	2019-2025
Institutional Reports	Case Studies	5	2023-2026
Classical Islamic Texts	Educational Philosophy	4	Various
International Reports	UNESCO/Policy Bodies	3	2021-2025
Total		45	

3.5 Data Analysis Techniques

Data analysis employed thematic content analysis as the primary analytical technique. This involved multiple stages: initial reading of sources to gain familiarity with the material, systematic coding of relevant passages according to predetermined and emergent themes, categorization of codes into broader thematic clusters, and interpretive synthesis of themes to address the research questions (Farhan et al., 2026). The analysis was guided by the theoretical framework incorporating Rogers' diffusion theory, maqasid al-shariah principles, and digital Islamic studies perspectives. Descriptive analysis documented patterns in AI adoption across different institutional contexts. Critical analysis evaluated the implications of observed practices for Islamic epistemology and pedagogical traditions. Normative analysis drew upon Islamic ethical principles to propose frameworks for responsible AI

integration. The triangulation of multiple data sources enhanced the credibility of findings, while reflexive engagement with researcher positionality addressed potential biases in interpretation. The analytical process was iterative, with findings from initial analysis informing subsequent rounds of data collection and interpretation until thematic saturation was achieved.

4. RESULTS

4.1 Current Practices of AI Integration in Pesantren

The analysis reveals that Indonesian pesantren are engaging with artificial intelligence technologies in diverse ways that reflect their institutional orientations and resources. AI adoption in pesantren encompasses multiple domains including teaching and learning processes, administrative management, and outreach activities (Rahmawati et al., 2026). The primary finding is that pesantren institutions demonstrate considerable adaptive capacity, integrating new technologies to improve educational quality while maintaining their foundational values and traditions (Abidin & Fadlullah, 2025). This finding challenges assumptions that traditional institutions are inherently resistant to technological change, instead revealing strategic and selective engagement with digital innovations.

The specific forms of AI implementation observed in pesantren contexts include: (1) online learning platforms such as Learning Management Systems that enable hybrid instructional models combining face-to-face and digital learning; (2) digital Islamic applications including digital Quran platforms with AI-powered tajwid evaluation and Maktabah Syamilah for accessing classical texts; (3) AI-based chatbots that respond to religious inquiries and support student learning outside formal instructional hours; (4) learning analytics systems that track student progress and identify learning difficulties; and (5) administrative information systems that enhance institutional management efficiency (Abidin & Fadlullah, 2025). Studies document that modern pesantren and those affiliated with national education standards have adopted more comprehensive AI integration, while traditional salafiyah pesantren maintain more limited engagement focused primarily on digital reference tools (Sofi et al., 2025).

Table 3: Key AI Technologies Implemented in Indonesian Pesantren

Technology Type	Application
Implementation Level	Primary Benefit
Learning Management Systems	Course delivery, assessment
Moderate-High	Administrative efficiency
Digital Quran Applications	Tajwid evaluation, memorization
High	Personalized learning
Maktabah Syamilah	Classical text

The implementation of AI varies significantly across pesantren contexts. Urban pesantren with greater access to technological infrastructure demonstrate more extensive AI adoption compared to rural institutions facing connectivity challenges (Saputro & Arif, 2025). Large modern pesantren such as Gontor have implemented systematic digital integration including technology-based curriculum, while smaller traditional pesantren maintain classical methods with selective use of digital tools (Dacholfany et al., 2023). The role of institutional leadership proves decisive, with kyai who possess openness to innovation facilitating more comprehensive technology adoption (Abidin & Fadlullah, 2025). Research indicates that pesantren in Java and major urban centers lead in AI integration, while those in remote regions face persistent barriers including limited electricity supply and internet connectivity (Efrizal et al., 2024). Despite these variations, a common pattern emerges: pesantren across typologies seek to balance technological adoption with preservation of their distinctive educational identity.

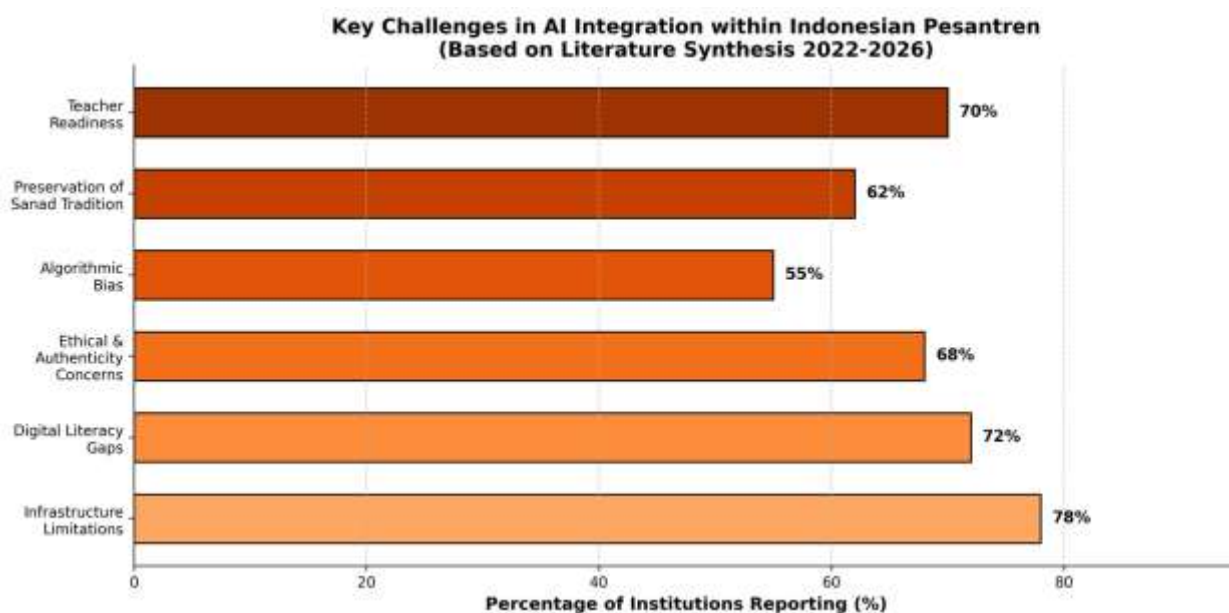


Figure 4. Key Challenges in AI (Source: Authors' calculation)

4.2 Factors Enabling and Constraining AI Integration

The analysis identifies several factors that enable successful AI integration in pesantren education. Leadership commitment from kyai and pesantren administrators emerges as the most critical enabling factor, as institutional decision-makers shape the strategic direction of technology adoption (Rahmawati et al., 2026). Governance frameworks that provide clear guidelines for technology use while respecting traditional values facilitate responsible implementation. Digital literacy development among teachers and students creates the competencies necessary for effective technology utilization. External support through government programs, university partnerships, and technology developer collaborations provides resources and expertise that individual institutions may lack (Pratama & Muhammad, 2025). The inherent adaptability of pesantren institutions, demonstrated throughout their history of negotiating modernity while preserving traditions, provides a foundation for engaging constructively with AI technologies (Sofi et al., 2025).

Multiple factors constrain AI integration in pesantren contexts. Infrastructure limitations remain the most frequently cited barrier, including inadequate internet connectivity, insufficient hardware, and unreliable electricity supply in remote locations (Achruh et al., 2024). Teacher readiness constitutes another significant constraint, as many educators lack the digital competencies and pedagogical knowledge necessary to integrate AI effectively into religious instruction (Siregar et al., 2025). Financial constraints limit the capacity of pesantren, particularly those relying on community donations, to invest in technology infrastructure and training programs. Cultural and theological concerns also constrain adoption, with some pesantren communities expressing reservations about technologies perceived as threatening traditional authority structures or introducing content inconsistent with Islamic values (Studi et al., 2025). The absence of clear regulatory frameworks and curriculum standards for AI integration in Islamic education creates uncertainty for institutions attempting to navigate digital transformation responsibly.

Beyond practical constraints, the analysis reveals deeper ethical and epistemological challenges that require careful consideration. The authenticity of religious knowledge transmitted through AI systems raises fundamental questions about the validity of learning that bypasses direct human scholarly authority (Abusharif, 2024). Algorithmic bias embedded in AI systems may propagate perspectives or content that conflicts with Islamic teachings or marginalizes particular interpretive traditions (Muzakky & Sholihah, 2026). Data privacy concerns emerge as AI systems collect and analyze student information in ways that may violate principles of trust (*amanah*) and individual dignity (Farhan et al., 2026).

Perhaps most significantly, the potential erosion of the relational and spiritual dimensions of pesantren education, including the ta'dzim relationship between santri and kyai, threatens the distinctive contribution of pesantren to character formation (Maryam, 2023). These challenges underscore the need for ethically grounded frameworks that address not only technical implementation but also the deeper implications of AI for Islamic educational philosophy.

4.3 Framework for Ethical AI Integration

Based on the analysis of current practices and critical evaluation of challenges, this study proposes an integrative framework for ethical AI integration in pesantren education. The framework positions AI as a *wasilah* (instrumental means) that supports human educators rather than replacing their essential roles as *murabbi* (character formers) and spiritual guides (Haq & Adiningsih, 2025). It is grounded in *maqasid al-shariah* principles, particularly *hifz al-din* (protection of religion) and *hifz al-aql* (protection of intellect), ensuring that technological adoption aligns with the fundamental objectives of Islamic education (Rosmaini, 2025). The framework emphasizes hybrid models that combine the benefits of AI-enhanced learning with the irreplaceable elements of face-to-face mentorship, maintaining the embodied knowledge transmission that authenticates religious learning through personal connection with qualified scholars (Sulthon et al., 2025).

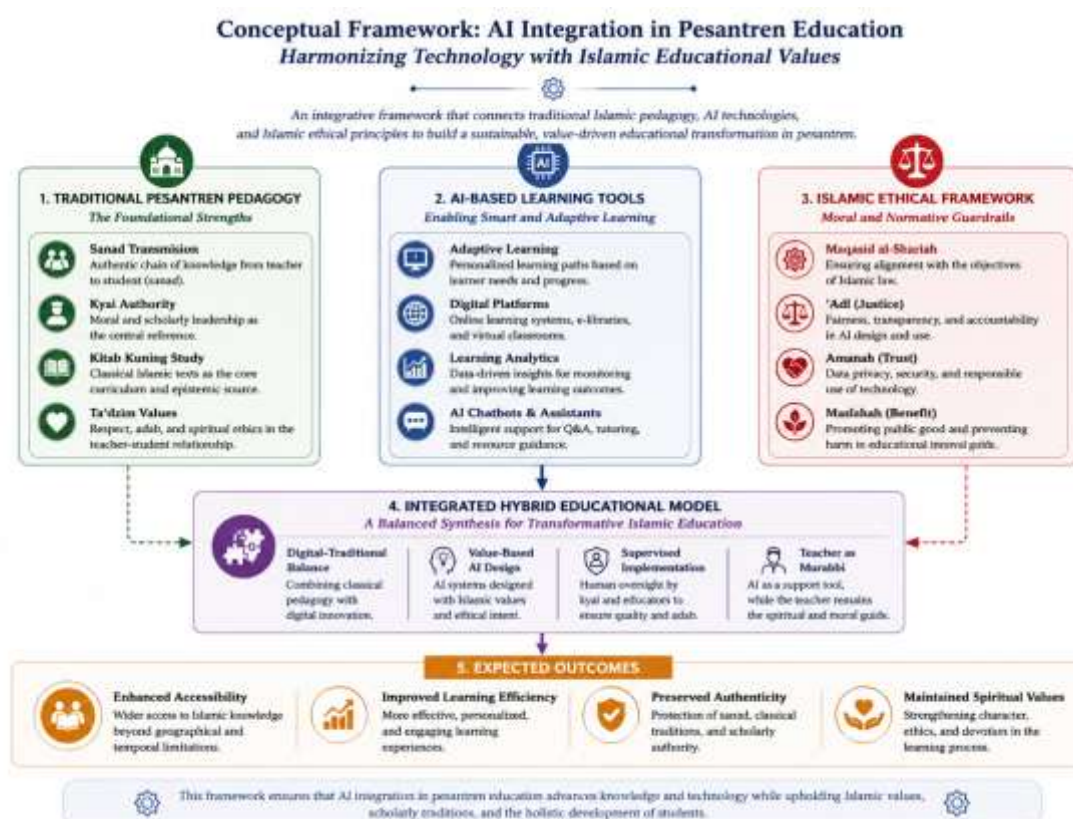


Figure 5. Conceptual Framework (Components Source: Processed by the authors)

The proposed framework comprises five interrelated components (figure 5). First, value-based AI design ensures that AI tools implemented in pesantren contexts are developed and evaluated according to Islamic ethical principles including justice (*'adl*), trustworthiness (*amanah*), and public benefit (*maslahah*) (Warisno et al., 2025). Second, transparency and accountability mechanisms require that algorithmic processes be explainable and that human oversight be maintained over AI-driven educational decisions (Prasidha, 2026). Third, teacher empowerment prioritizes capacity building for educators to integrate AI tools effectively while maintaining their role as the primary agents of religious and moral instruction (Zain et al., 2025). Fourth, preservation of *sanad* tradition ensures that AI supports rather than supplants the authenticated chain of knowledge transmission through qualified scholars

(Akbar et al., 2024). Fifth, institutional governance establishes clear policies and oversight structures that guide responsible AI implementation while remaining responsive to emerging challenges and opportunities.

The implementation of this framework carries significant implications for pesantren institutions, policymakers, and technology developers. Pesantren administrators should develop institutional policies that articulate clear principles and guidelines for AI adoption aligned with their educational mission and values. Teacher training programs must be expanded to include both technical competencies in utilizing AI tools and ethical literacy regarding the responsible integration of technology in religious education (Achruh et al., 2024). Curriculum design should incorporate AI as a complementary resource while maintaining the centrality of kitab kuning study, kyai-led instruction, and community-based character formation. Policymakers should develop national standards and regulatory frameworks that support responsible AI integration in Islamic education while providing resources for infrastructure development and capacity building. Technology developers should engage with Islamic scholars and pesantren educators to ensure that AI tools are designed with sensitivity to Islamic values and pedagogical traditions (Muksin et al., 2026). Collaboration among these stakeholders is essential for realizing the transformative potential of AI while preserving the distinctive contributions of pesantren education.

5. DISCUSSION

5.1 Contextualization within Indonesian Islamic Education

The findings must be understood within the broader context of Islamic education transformation in Indonesia. Pesantren institutions have demonstrated remarkable resilience and adaptability throughout their history, navigating colonial pressures, state policies, and social changes while preserving their distinctive identity (Sofi et al., 2025). The current engagement with AI represents the latest chapter in this ongoing negotiation between tradition and modernity. Indonesian Islamic education institutions, including pesantren, madrasah, and Islamic universities, have progressively adopted digital technologies while maintaining commitment to religious values and moral formation (Fian & Roqib, 2025). The principle of *al-muhafadzatu 'ala al-qadimi al-salihi wa al-akhdu bi al-jadidi al-aslah* (preserving beneficial traditions while adopting beneficial innovations) provides an indigenous framework for understanding how pesantren approach technological change (Mutammam et al., 2025). The findings suggest that successful AI integration occurs when it is aligned with this principle, enhancing the capacity of pesantren to fulfill their educational mission without compromising their foundational values.

The findings can be interpreted through multiple theoretical lenses that illuminate the dynamics of AI adoption in pesantren contexts. From the perspective of Rogers' Diffusion of Innovations Theory, pesantren institutions function as complex social systems in which adoption decisions are influenced by perceived attributes of innovations, communication channels, and the authority of opinion leaders, particularly the kyai (Wedi et al., 2025). The observed variations in AI adoption across different pesantren typologies reflect differing assessments of the relative advantage, compatibility, and complexity of AI technologies in relation to existing practices. From the perspective of Islamic epistemology, the findings highlight tensions between transmitted knowledge (*'ilm naqliy*) authenticated through sanad and rational knowledge (*'ilm 'aqliy*) that can be accessed through various means including digital technologies (Andrini et al., 2025). AI technologies primarily support access to the latter while raising questions about their capacity to transmit the former, which requires personal connection with qualified scholars. The concept of *maqasid al-shariah* provides a framework for evaluating AI integration according to whether it advances or threatens the fundamental objectives of Islamic education, particularly the protection of religion and intellect (Habib, 2025).

5.2 Understanding the Hybrid Knowledge Environment

A central finding of this study is the emergence of hybrid knowledge environments in pesantren that integrate AI systems with traditional pedagogical authority. This hybridity is not simply the

coexistence of old and new technologies but represents a reconceptualization of how religious knowledge is produced, accessed, and validated (Rahmawati et al., 2026). In these environments, AI tools expand access to textual resources and enable personalized learning pathways, while the kyai maintains authority over interpretation, spiritual guidance, and the authentication of knowledge through personal transmission. This configuration aligns with the classical Islamic educational distinction between technical knowledge that can be acquired through various means and wisdom (*hikmah*) that requires formation through mentorship (Mahfud & Maarif, 2026). The success of hybrid models depends on clearly delineating the appropriate roles of AI systems and human educators, ensuring that technological tools serve instrumental purposes while educators maintain their essential function as character formers (*murabbi*) and spiritual exemplars (*uswah*). The framework proposed in this study operationalizes this distinction by positioning AI as *wasilah* (means) under human supervision rather than as an autonomous educational agent.

The findings of this study both confirm and extend previous research on AI integration in Islamic education. Consistent with earlier studies, this research confirms that AI technologies enhance learning accessibility, efficiency, and engagement when appropriately implemented (Pratama & Muhammad, 2025). The identification of infrastructure limitations and teacher readiness as key barriers corroborates findings from studies across various Islamic educational contexts (Achruh et al., 2024). However, this study extends previous research by systematically analyzing the implications of AI for the distinctive pedagogical traditions of pesantren, particularly sanad-based knowledge transmission and the *ta'dzim* relationship between *santri* and *kyai*. While earlier studies have acknowledged ethical concerns related to AI, few have offered comprehensive frameworks grounded in Islamic jurisprudence for addressing these concerns. The integrative framework proposed in this study, with its emphasis on *maqasid al-shariah* principles and value-based AI design, contributes a normative dimension largely absent from predominantly descriptive previous research. Furthermore, this study challenges assumptions that traditional institutions are inherently resistant to technological change, revealing instead the strategic adaptability of pesantren in selectively engaging with innovations that align with their educational mission.

5.3 Implications

The findings carry significant implications at theoretical, practical, and policy levels. Theoretically, the study contributes to the emerging field of digital Islamic studies by demonstrating how traditional Islamic educational institutions negotiate technological change while preserving epistemological authenticity. It extends innovation diffusion theory to religious institutional contexts where adoption decisions involve not only technical assessments but also theological and ethical considerations. Practically, the study provides guidance for pesantren administrators and educators seeking to integrate AI responsibly, emphasizing the importance of leadership commitment, teacher capacity building, and clear institutional policies grounded in Islamic values (Rahmawati et al., 2026). The proposed framework offers actionable components that can inform institutional planning and implementation. At the policy level, the findings underscore the need for government attention to infrastructure development in remote pesantren, national standards for AI integration in Islamic education, and support for teacher training programs that build both technical and ethical competencies (Achruh et al., 2024). The study also highlights the importance of collaboration among pesantren institutions, Islamic scholars, policymakers, and technology developers to ensure that AI tools are designed and implemented with sensitivity to Islamic values and pedagogical traditions.

6. CONCLUSION

This study demonstrates that the integration of artificial intelligence into Indonesian pesantren is not merely a technological shift but a transformation of Islamic knowledge transmission, religious authority, and pedagogical culture. The findings reveal the emergence of a hybrid educational model in which AI-driven learning systems coexist with sanad-based traditions and kyai-centered authority. While AI significantly expands access to Islamic learning, accelerates knowledge dissemination, and

improves educational efficiency, it also creates critical tensions concerning the authenticity of religious interpretation, the weakening of direct teacher–student interaction, and the erosion of spiritual learning dimensions embedded in traditional pesantren pedagogy. The principal novelty of this study lies in its argument that AI should not be positioned as a substitute for Islamic scholarly authority, but as a *wasilah* (instrumental medium) operating within the ethical and epistemological framework of *maqasid al-shariah*.

The study further contributes theoretically by developing an integrative framework that combines Islamic epistemology, digital Islamic studies, and technology ethics to explain how religious educational institutions negotiate technological modernity. Unlike dominant technology adoption models that prioritize efficiency and innovation, this research demonstrates that pesantren evaluate AI through normative considerations of religious legitimacy, moral responsibility, and preservation of *sanad* traditions. This perspective expands the application of Diffusion of Innovations Theory by incorporating spiritual authority and ethical accountability as central determinants of technological acceptance in Islamic educational settings. Methodologically, the study shows the importance of combining conceptual, normative, and institutional analysis in examining the intersection of religion and emerging technologies, thereby offering a framework applicable to broader Muslim educational contexts.

The practical implications of this research emphasize the necessity of developing Sharia-oriented AI governance in pesantren education. Institutional policies should ensure that AI functions as a complementary pedagogical tool rather than replacing the interpretive and spiritual authority of *ulama* and *kyai*. Strengthening digital literacy, ethical supervision, and teacher competency is essential to prevent algorithmic bias, misinformation, and the commodification of religious knowledge. This study also identifies an important research gap concerning the long-term impact of AI on spiritual formation, character education, and religious authority among *santri*. Future studies should therefore prioritize empirical and longitudinal investigations into AI-mediated Islamic learning and formulate operational models for ethically grounded and Sharia-compliant AI implementation within Muslim educational institutions.

7. CRediT Author Statement

Gita Faddilah Islam: Conceptualization, Methodology, Investigation, Data Curation, Formal Analysis, Writing – Original Draft, Visualization, Validation. **Ravida:** Supervision, Methodology, Validation, Resources, Writing – Review & Editing, Project Administration, Funding Acquisition.

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