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Challenges of Digital Transformation in Pesantren in the 2018–2026 Literature: A Systematic Literature Review

Fatimah Tri Andini[1], Oca Alini Rasmita[2], Toyo Widodo[3]
Islamic Education Management Study Program, Faculty of Tarbiyah and Teacher Training,
Universitas Islam Negeri Raden Fatah, Palembang, Indonesia
Email: [1]fatimahtriandini2@gmail.com, [2]ocaalinirasmita@gmail.com, [3]toyopaldas@gmail.com

Abstract

Digital transformation offers pesantren opportunities to improve learning, administration, communication, and access to knowledge, but adoption also raises infrastructure, human-capacity, governance, and cultural challenges. This article reviews literature published between 2018 and 2026 to map the principal challenges discussed in research on digital transformation in Indonesian pesantren. A structured literature review was developed using targeted searches of scholarly web indexes and journal repositories, with terms relating to pesantren, digitalization, information technology, learning, and management. Relevant publications were screened for topical relevance and synthesized thematically. The accessible literature points to five interrelated challenge areas: unequal access to stable internet and suitable devices; uneven digital literacy among educators and students; limited institutional capacity for planning, maintenance, and data governance; pedagogical integration that may remain at the level of using tools rather than redesigning learning; and the need to protect religious learning traditions, privacy, and ethical conduct in digital environments. Studies also describe constructive uses of technology in teaching and institutional administration, suggesting that digital adoption is not inherently opposed to pesantren identity. Instead, outcomes depend on leadership, staff development, infrastructure, and clear educational purposes. The review is exploratory because the search and screening records have not yet been independently reproduced across all major databases; therefore, it does not claim a complete PRISMA count or exhaustive coverage. The article concludes that a context-sensitive, staged, and values-based transformation strategy is more appropriate than technology procurement alone.

Keywords: *Digital transformation, pesantren, digital literacy, educational technology, systematic literature review*

INTRODUCTION

Pesantren are Islamic educational institutions that combine religious instruction, character formation, communal life, and pedagogical relationships among the *kiai*, *ustaz*, and students (*santri*). Digital technology is changing how knowledge is produced, stored, disseminated, and managed. In the pesantren context, this change concerns not only the use of devices or platforms but also how institutions set limits on technology use, organize learning, protect data, and sustain scholarly traditions.

Digital transformation needs to be distinguished from administrative digitalization, which merely moves manual processes into applications. Transformation involves adjusting work processes, human competence, governance, and organizational culture so that technology supports institutional goals. Because pesantren differ in form, resources, and educational orientation, implementation cannot be generalized. A pesantren with adequate connectivity and

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technical staff will face different problems from an institution that still relies on limited infrastructure.

Previous studies have discussed the use of technology in pesantren learning and programs. Rajab, Zulmuqim, and Hidayatullah (2020), for example, examined the development of an information-technology-based learning model in pesantren in West Sumatra. Wiyanto, Sudjarwo, and Nurwahidin (2022) synthesized the role of technology in implementing pesantren programs and reported its use in learning and institutional services. Yanto, Abdullah, and Zulfiqri (2023) described the digitalization of Pesantren Darul Mustafa through a number of information and administrative services. These studies show a range of uses but also underline the need to read technology adoption within specific organizational and educational contexts.

On the other hand, the use of technology raises critical questions. Does the availability of a platform automatically improve the quality of learning? How do institutions ensure that teachers and santri are able to evaluate digital information? Who is responsible for the security of santri and administrative data? How can technology expand access without displacing the values of *adab*, scholarly authority, and the direct interaction that are important in pesantren education? These questions call for a cross-study synthesis, not merely a list of the applications in use.

This article aims to map the challenges of digital transformation in pesantren in the 2018–2026 literature, group the recurring themes of challenges, and formulate implications for institutional policy and practice. The article's contribution lies in an integrated reading of the technical, pedagogical, human, governance, and sociocultural aspects. Because the searches available in preparing this draft have not been verified through record export and independent screening across all databases, the results are positioned as a structured exploratory synthesis that needs to be completed before it is declared a final SLR.

METHODS

This article uses a structured literature review approach oriented toward a systematic literature review (SLR). The publication range was set at 2018–2026, and the unit of analysis was journal articles discussing the use of, or challenges in using, digital technology in pesantren in Indonesia, including aspects of learning, governance, information systems, digital literacy, and institutional adaptation. The PRISMA 2020 guideline was used as a reference for transparent reporting of the identification, screening, eligibility, and inclusion processes (Page et al., 2021).

The initial search was carried out on online scholarly indexes and journal repositories accessible through the web, using combinations of Indonesian and English terms such as "transformasi digital pesantren", "digitalisasi pesantren", "teknologi informasi pesantren", "pesantren digital transformation", "Islamic boarding school technology", and "digital literacy pesantren". The search produced a set of relevant publications whose metadata and abstracts could be examined, including the studies by Rajab et al. (2020), Wiyanto et al. (2022), and Yanto et al. (2023). Articles that discussed educational technology in general without a clear link to pesantren were not treated as primary evidence for conclusions about pesantren.

The planned inclusion criteria were: publication within 2018–2026; discussion of pesantren in Indonesia or of technology practices explicitly related to pesantren; availability of metadata and an abstract or sufficient text to assess; and relevance to one or more research questions. The exclusion criteria covered duplicates, non-scholarly writing that could not be verified, and articles that mentioned pesantren only in passing. The data recorded included author, year, focus of study, reported method, technology use, challenges, and recommendations.

The analysis was carried out through thematic synthesis. Similar findings were grouped into the themes of infrastructure, digital competence, pedagogy, governance, and identity and ethics. The synthesis does not assume that all articles have equal evidentiary strength: case studies provide contextual description, while earlier SLRs offer broader synthesis but still depend on the scope and quality of the sources they used.

It should be emphasized that this draft does not include counts of initial records, the number of duplicates, reasons for exclusion at the full-text stage, or quality appraisal that has been independently replicated. Therefore, PRISMA flow figures are not reported so as not to create unverified data. To make it a submission-ready SLR, the search needs to be re-run and

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documented reproducibly on specified databases, accompanied by an extraction table, a list of articles actually included, and a final PRISMA diagram.

DISCUSSION

1. Infrastructure and Digital Access Gaps

   The most fundamental challenge is the availability of stable connectivity, devices, electricity, and technical support. Uneven internet access can limit the use of online learning resources, communication with parents, app-based administration, and teacher training. This problem is not solved simply by providing a network: devices must fit needs, subscription costs must be sustainable, and someone must handle maintenance and technical disruptions.

   Access gaps may also produce unequal learning experiences. When digital materials become part of learning activities, santri with better access may gain greater advantages than those with limited access. Therefore, the choice of technology needs to consider the economic capacity of the institution and its santri, the availability of offline materials, and the possibility of sharing devices regularly. Data-efficient designs that can be used without a constant connection may suit some pesantren better than platforms that demand high connectivity.

   The findings on technology use across various pesantren programs summarized by Wiyanto et al. (2022) show that technology use is not limited to learning but can extend to institutional services. This expansion makes infrastructure planning even more important: failures in administrative systems can affect payment records, santri data, and communication. Investment should cover the total cost of ownership, security, maintenance, and a recovery plan for when services are disrupted.

2. Digital Literacy and Human Resource Readiness

   Having devices does not automatically mean being ready to use them. Digital literacy includes the ability to operate tools, find and assess the credibility of information, communicate safely, understand privacy, and produce content responsibly. Educators need support to choose technology according to learning goals, not only basic technical skills. Santri also need guidance to distinguish accountable Islamic sources from information whose authority and context are unclear.

   Rajab et al. (2020) raised the need to develop information-technology-based learning in pesantren, including the problems of learning that is still teacher-centered and of limited literacy patterns. The implication is not that traditional approaches should be abolished, but that technology should be used to enrich the learning process. For example, digital materials can help with reviewing content, accessing references, and enriching learning, while *talaqqi*, *sorogan*, *bandongan*, discussion, and direct guidance continue to be maintained according to learning objectives.

   Competence development needs to be continuous and needs-based. Short training without mentoring is often not enough to change practice. Pesantren can develop staged training, internal mentors, communities of practice, and evaluation based on real examples of use. Success should be measured not merely by the number of training participants or installed applications but by educators' ability to design learning activities that are meaningful, safe, and suited to the character of the santri.

3. Pedagogical Integration: From Using Tools to Changing Practice

   Digital transformation in learning faces the risk of instrumentalism, that is, the belief that learning becomes modern simply because it uses presentations, videos, applications, or online classes. Meaningful integration begins with learning objectives, the nature of the material, the condition of the santri, and the role of the teacher. Technology is chosen when it genuinely helps understanding, feedback, collaboration, access to sources, or differentiation of learning.

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In pesantren, pedagogical integration requires special care because the educational process is not oriented only toward mastering information. The formation of *adab*, role modeling, discipline, worship habits, and teacher–santri relationships are important parts of the learning experience. Therefore, digital learning is better positioned as a purposeful complement than as a universal replacement for direct interaction. Digital religious materials also require curation and source verification so that ease of access is not equated with validity of content.

The studies discussed show various entry points for technology, from information-technology-based learning models (Rajab et al., 2020) to a synthesis of technology use in pesantren programs (Wiyanto et al., 2022). However, the evaluation of long-term impact still needs to be strengthened. Future research needs to measure not only user acceptance or frequency of use but also understanding of the material, quality of interaction, santri engagement, equitable access, and fit with the educational goals of pesantren.

4. Governance, Leadership, and System Sustainability

Digital transformation is an organizational change, so technology decisions need clear direction and clear persons in charge. Pesantren need to set priority needs, data management standards, account access procedures, backups, data recovery, and ways of handling incidents. Using different applications without coordination can lead to duplicated data, dependence on particular providers, and difficulties when administrators change.

The digitalization of Pesantren Darul Mustafa described by Yanto et al. (2023) involved using systems for online registration, payments, attendance, assessment, and general information. This example shows the potential for service efficiency but also raises needs for data integration, maintenance, and clarity of responsibility. A digital system should not be seen as a one-time project; operating budgets, documentation, training for new administrators, and alternative procedures when the system cannot be accessed are all required.

Pesantren leadership plays a role in building shared goals and explaining the reasons for using technology to teachers, santri, caregivers, and parents. Changes imposed without dialogue can provoke resistance or merely formal use. Conversely, decisions that involve users from needs mapping through evaluation have a chance of increasing a sense of ownership. Good governance also requires clear limits on who may access sensitive information and how long data are kept.

5. Pesantren Identity, Ethics, and Digital Security

Pesantren face the need to balance openness to technology with protecting their identity and value system. The challenge is not simply accepting or rejecting technology but determining which technology is appropriate to use, for what purpose, by whom, and under what kind of supervision. Digital access can broaden knowledge but also exposes santri to misinformation, age-inappropriate content, cyberbullying, privacy violations, and social media use that disrupts concentration.

Institutional responses need to avoid two extremes. Blanket restrictions without literacy education risk leaving santri unprepared for the digital environment outside the pesantren. Conversely, access without guidance can ignore security risks and educational aims. A more balanced approach includes transparent usage rules, mentoring, source curation, communication ethics education, and channels for reporting problems. Policies should be proportionate to santri's age and learning needs.

Pesantren values can serve as an ethical foundation for using technology responsibly, for example *amanah* in managing data, *tabayyun* when checking information, *adab* in communication, and responsibility in disseminating materials. These principles should be translated into practical policy, not merely slogans. Personal data protection also requires collecting only necessary data, restricting access, strong passwords, secure backups, and care in uploading santri's photos or information.

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6. Thematic Synthesis and Development Agenda

Table 1. Thematic synthesis of the challenges of digital transformation in pesantren

Theme	Form of Challenge	Direction of Response
Infrastructure	Uneven connectivity, devices, costs, and maintenance	Needs audit, data-efficient solutions, offline materials, sustainable budgeting
Human resources and literacy	Skills gaps and gaps in evaluating digital information	Continuous training, mentors, source curation, safe practices
Pedagogy	Technology used as a tool without a clear learning design	Start from learning objectives, evaluate impact, retain essential interactions
Governance	Fragmented data, unclear roles, dependence on providers	Data policy, responsible persons, backups, documentation and alternative procedures
Ethics and identity	Privacy, misinformation, digital *adab*, and the balance between tradition and innovation	Mentoring, transparent rules, *tabayyun*, data protection, and evaluation of values

Overall, these themes are interrelated. Weak infrastructure limits learning practice; low competence reduces the benefits of devices; unclear governance increases security risks; and policies that are insensitive to pesantren values can hinder acceptance. Therefore, transformation strategies should be carried out in stages: (1) mapping needs and risks; (2) choosing a few realistic priorities; (3) preparing human resources and usage rules; (4) running limited pilots; and (5) evaluating benefits, costs, equity, security, and fit with educational goals.

The available literature also has limitations. Some studies are descriptive or focus on a single institution, while published SLRs differ in the scope of their questions and periods. This means generalizations to all pesantren must be made carefully. Future research needs to compare *salafiyah*, modern, and combined pesantren; examine variation by region and economic capacity; and use longitudinal designs to assess whether transformation really improves the quality of services and learning. Developing evaluation indicators agreed with pesantren stakeholders will help distinguish substantive innovation from merely symbolic technology adoption.

CONCLUSION

The 2018–2026 literature identified in the initial search shows that digital transformation in pesantren offers opportunities in learning and administration as well as interrelated challenges. The main challenges include infrastructure gaps, the readiness and digital literacy of human resources, the integration of technology into pedagogy, governance and data security, and efforts to preserve the values and traditions of pesantren education. These challenges cannot be resolved merely by adding devices or installing applications, because the success of transformation depends on human capacity, leadership, operational support, and clarity of educational goals.

The practical implication is that pesantren need to design transformation in stages that are needs-based, safe, inclusive, and value-driven. Technology should strengthen—rather than automatically replace—educational relationships, the deepening of knowledge, and the formation of *adab*. Academically, this draft provides an initial thematic mapping but cannot yet be treated as

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a final, fully replicable SLR because the identification and screening process is not yet accompanied by verified PRISMA counts and documented quality appraisal. The next stage must repeat the search systematically, archive all records, document reasons for exclusion, and test the consistency of data extraction before publication.

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