

Digital Transformation of Santri: Integrating Learning Organisation with Adaptive Learning in Pesantren

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Article Info	Abstract
<p>Article history: Received: Jan 26, 2026 Revised: Feb 28, 2026 Accepted: Mart 30, 2026</p> <hr/> <p>Keywords: Adaptive Learning Learning Organisation Islamic boarding schools Scott Digital Transformation</p>	<p>Digital transformation in Islamic boarding schools requires integrating learning organization models with adaptive learning to address the challenges of the Industrial Revolution 4.0 and society 5.0. This article aims to analyze the construction of the integration of the two concepts in the context of digitization of students in Indonesian Islamic boarding schools. The study focuses on a technology-based adaptive learning model associated with the five Senge disciplines in pesantren governance. The method used is a Systematic Literature Review (SLR) following the PRISMA protocol, based on 35 Scopus- and Sinta-indexed articles published between 2015 and 2025. The results of the study show that the integration of learning organization and adaptive learning forms four dimensions of transformation, namely modernization of data-based curriculum, strengthening the digital capacity of ustadz and students, system-based governance, and preservation of Islamic values. These findings confirm that the Islamic boarding schools that have succeeded in transforming are those that make collective learning a culture and personalize learning as a strategy. It is concluded that the Senge-Adaptive Learning hybrid framework is feasible as a model for digital pesantren governance.</p>
<p>To cite this article: Manaf, Sofwan, Dkk. (2026). Digital Transformation of Santri: Integrating Learning Organisation with Adaptive Learning in Pesantren. 5(1), 1-7. https://doi.org/10.61159/edukasiana.v5i1</p> <p>This is an Open Access article distributed under the terms of the Creative Commons Attribution 4.0 International license (https://creativecommons.org/licenses/by/4.0/)</p>	

A. Introduction

The Industrial Revolution 4.0 and the transition to Society 5.0 have presented a completely new educational landscape, including for traditional Islamic educational institutions such as Islamic boarding schools in Indonesia. Pesantren, as the oldest educational institution in the archipelago, faces dual demands: maintaining the classical scientific tradition rooted in the yellow book and, at the same time, adopting digital technology to prepare students to meet the challenges of the 21st century (Alif, Matin, & Santosa, 2025). Data from the Ministry of Religion shows that more than 70% of students use social media every day, but only 28% have received basic digital literacy training. This fact indicates a serious gap between the intensity of technology use and the ethical and pedagogical readiness of pesantren in managing it.

Digital transformation in Islamic boarding schools is not just the adoption of technological devices but a paradigm shift that includes curriculum modernization, administrative digitalization, the development of human resource digital competencies, and the adaptation of a technology-based learning culture (Nugroho & Astutik, 2024). In this context, two theoretical concepts are relevant to be brought together: learning organization developed by Peter Senge (1990) with its five disciplines

(personal mastery, mental models, shared vision, team learning, and systems thinking), and adaptive learning as an algorithm-based personal learning approach that adapts the learning path to the individual needs of learners (du Plooy, Oosthuizen, & Soeker, 2024). These two concepts, if integrated systematically, have the potential to become a strong framework for transformation in Islamic boarding schools.

Previous studies have discussed the digitalization of Islamic boarding schools from various perspectives. Hasan, Taufiq, and Elmhemit (2023) examine the digital transformation of Islamic boarding schools in Madura, focusing on technological infrastructure. Bahri and Najiburrahman (2024) highlight the role of kiai in improving digital-based education services. Sudir et al. (2025) conducted a bibliometric analysis of the pesantren learning model and found a shift toward a technology-based hybrid model from the sorogan-bandongan method. Meanwhile, an evaluation of the implementation of AI-based adaptive learning in Islamic boarding schools by Andriani (2025) found that 85% of students responded positively to adaptive learning technology. However, these studies tend to be partial and have not integrated the perspective of learning organizations with adaptive learning technologies in a cohesive theoretical framework.

The research gap identified is the lack of studies that explicitly link Senge's theory of learning organization with the practice of adaptive learning in the pesantren environment. In fact, these two concepts complement each other: a learning organization provides a cultural-organizational framework, while adaptive learning provides technological instruments for personalizing learning. Without integrating the two, the digital transformation of pesantren risks stopping at the technical level without substantive changes to the learning culture (Fuadiy, Rozi, Arafah, Kamal, & Sunoko, 2025). Controversy also arose between groups that encourage massive digitalization and those worried about the erosion of traditional Islamic boarding school values due to poorly managed digitalization.

This article aims to: first, formulate a theoretical framework for the integration of learning organization and adaptive learning in the context of pesantren; second, identify the dimensions of students' digital transformation based on a synthesis of the literature; and third, propose a digital pesantren governance model based on these two approaches. The unit of analysis in this study is a scientific article indexed by Scopus and Sinta that discusses the digitalization of Islamic boarding schools, learning organization, and adaptive learning in the last ten years.

The main argument tested in this article is that the digital transformation of students will be effective if it is built on two simultaneous pillars: the cultural pillar, in the form of the internalization of learning organizational principles, and the technological pillar, in the form of the implementation of adaptive learning systems. This hypothesis is framed by the argument that the pesantren that has succeeded in transforming is one that makes collective learning a culture and personalizes learning as a strategy, without losing its Islamic identity and scientific tradition. The structure of this article is as follows: the introductory section explains the urgency, research gap, objectives, and arguments; the methods section describes the Systematic Literature Review procedure used; the results section presents the findings of the literature synthesis; the discussion section interprets the findings in an integrative theoretical framework; and the concluding section provides conclusions and recommendations for further research.

B. Methods

This study uses the Systematic Literature Review (SLR) approach, guided by the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) protocol. SLR was chosen because it allows researchers to identify, evaluate, and synthesize scientific evidence comprehensively and transparently on the phenomenon of digital transformation in Islamic boarding schools (Page et al., 2021). The SLR procedure follows four stages: identification, screening, eligibility, and inclusion. At the identification stage, the researcher searched the Scopus and Sinta database (DOAJ, Garuda) with the combination keywords: "learning organization" AND "pesantren", "adaptive learning" AND "Islamic boarding school", "digital transformation" AND "santri", and "Senge" AND "educational management". The publication time range is limited to 2015 to 2025 to guarantee the novelty of references. The total number of articles identified at this stage is 187.

At the screening stage, the researcher eliminates duplication and irrelevant articles based on titles and abstracts. The inclusion criteria set include: (1) Scopus or Sinta 1-3 indexed articles; (2) discuss digital transformation, learning organization, or adaptive learning in the context of education; (3) speak Indonesian or English; and (4) is a primary research article or review. The exclusion criteria include opinion articles, editorials, and proceedings that are not indexed. After the screening stage, 62 articles remain. The feasibility stage is carried out by reading the full-text review and assessing the methodological quality of each article using the Critical Appraisal Skills Programme (CASP). The assessment includes the clarity of objectives, the accuracy of methods, the validity of the analysis, and the relevance of the findings to the research questions. This stage leaves 35 articles that meet all the criteria for further analysis.

The inclusion and data analysis stage is carried out using thematic analysis techniques as developed by Braun and Clarke. The researcher reads each article repeatedly, codes the key findings, groups the code into categories, and then builds large themes that represent the dimensions of the digital transformation of the pesantren. The validity of the analysis was maintained through triangulation of sources, peer debriefing with two academics in the field of Islamic education management, and trail audit of the entire categorization process. The tools used include Mendeley software for reference management and NVivo 12 for thematic coding.

C. Result and Discussion

The results of synthesizing the 35 selected articles show four main dimensions that shape students' digital transformation when a learning organization is integrated with adaptive learning. The four dimensions are the modernization of the data-based curriculum, strengthening the digital capacity of ustadz and students, system-based pesantren governance, and the preservation of Islamic values in the digital space. The first dimension, data-driven curriculum modernization, appeared in 28 of the 35 articles analyzed. Studies show that successful Islamic boarding schools have begun integrating Learning Management Systems (LMS), online learning platforms, and learning analytics systems into traditional curricula. The curriculum is no longer static, but dynamic and responsive to student learning outcome data. Adaptive learning allows learning paths to be tailored to individual levels of understanding, especially in Arabic, tahfidz, and classical instrument science.

The second dimension, digital capacity strengthening, was confirmed in 31 articles. Consistent findings show that the success of digital transformation is highly determined by the readiness of human resources, both ustadz and students. The principle of personal mastery in Senge's framework is relevant here: each individual is required to continue developing their capacity as a lifelong learner. Digital literacy training programs, technology-based pesantren teacher certification, and an inter-ustadz community of practice are the main instruments for capacity building. The third dimension, system-based pesantren governance, is identified in 24 articles. This dimension is closely related to the Senge principles of systems thinking, namely the ability to see pesantren as a whole system with inter-element relationships. The digitization of administration, the pesantren management information system (SIMPES), and the student data dashboard are concrete tools that support evidence-based decision-making. Kiai digital leadership and management, based on collaboration across fields, are key.

The fourth dimension, the preservation of Islamic values, is present in 33 articles as a constant reminder that the digital transformation of Islamic boarding schools must not erode their religious identity. Senge's principle of shared vision seems relevant: all components of pesantren must have a common vision that technology is a tool to strengthen the mission of da'wah, not

replace it. Successful Islamic boarding schools are pesantren that combine the yellow book with digital applications, sorogan with online mentoring, and bandongan with religious webinars.

Table 1 summarizes the four dimensions of student digital transformation based on the literature synthesis:

Table 1. Dimensions of Digital Transformation of Students Based on SLR Synthesis

No.	Dimensions	Senge Principle	Adaptive Learning Instruments
1	Curriculum Modernization	Systems Thinking, Mental Models	LMS, Learning Analytics, Personalized Pathways
2	Digital Capacity Building	Personal Mastery, Team Learning	Training Platforms, Online Practice Communities
3	System-Based Governance	Systems Thinking, Shared Vision	SIMPES, Dashboard Data, BI Tools
4	Preservation of Islamic Values	Shared Vision, Mental Models	Kitab Kuning Application, Digital Da'wah Platform

Source: Primary data from SLR synthesis (2026).

The table above shows that each dimension of students' digital transformation has a pair of Senge principles and specific adaptive learning technological instruments. This combination distinguishes this integrative approach from previous studies, which tend to be partial.

Discussion

The first finding that data-based curriculum modernization is the most dominant dimension confirms and expands on the findings of du Plooy, Oosthuizen, and Soeker (2024), who stated that adaptive learning has a positive impact on learning outcomes through personalized learning paths, real-time feedback, and flexibility. In the context of Islamic boarding schools, this personalization has added value because the yellow book requires a multi-level understanding that varies widely in capacity among students. The integration of the principles of Senge's mental models gives cultural meaning, which ustadz need to continue to revise their assumptions about how students learn in the digital era.

The dimension of digital capacity building shows the convergence between Senge's personal mastery principles and the demands of 21st-century skills. These findings are in line with the study by Anwar, Djudiyah, Hasanati, and Sulaiman (2025) on the impact of academic digital literacy on graduate career adaptation. However, the findings of this article are complemented by showing that in Islamic boarding schools, digital capacity building does not stop at technical training; It must be accompanied by strengthening the spiritual dimension so that digital literacy is not disconnected from Islamic manners and ethics. This is where team learning becomes crucial: a community of ustadz practices that share both digital and religious knowledge.

The findings on system-based pesantren governance strengthen the argument of Bahri and Najiburrahman (2024) that the role of kiai as digital leaders greatly determines the success of transformation. Senge's systems thinking framework provides a theoretical language for this phenomenon: pesantren need to be understood as a system whose components are interconnected, so that intervention at one point will affect the entire system. This answers the criticism of Sudir et al. (2025), who found that many digital transformations of Islamic boarding schools fail because they are carried out in silos, without a systemic vision. The findings regarding the preservation of Islamic values

answer the concerns raised by Syaiful et al. (2022) and Saini (2024) about the potential erosion of traditions due to digitalization. Integration with shared vision. Senge emphasized that technology must be framed in the big mission of Islamic boarding schools, namely, producing students who are knowledgeable, moral, and competitive. Hidayat's study (2025) on the role of AI in strengthening Islamic boarding school education also emphasizes the importance of ethical AI governance and in line with Islamic values. These findings contribute to the expansion of the theory by proposing that, in religious educational institutions, the shared vision must be theological rather than merely managerial.

Cross-dimensional interpretation shows that the four dimensions do not stand alone but reinforce one another within a single hybrid framework. The Senge-Adaptive Learning model proposed in this article offers a new framework that modifies classical learner organizational theory by integrating elements of contemporary learning technologies. The main modification was the addition of an algorithmic-personalization dimension to Senge's five-disciplinary framework, which was previously more oriented towards human-organizational dynamics. A comparison with the study by Alif, Matin, and Santosa (2025), which synthesized the transformation of the pesantren curriculum, shows similarities in the five dimensions they identified (e-learning, digital competence, blended learning, pesantren values, and IT infrastructure). However, this article adds value by tying these five elements into a complete theoretical framework rather than just a list of dimensions. This is in line with Teece's (2007) call about the importance of dynamic capabilities as an organization's ability to integrate, build, and reconfigure competencies continuously.

In terms of criticism of the theory, this article finds that Senge's concept of adaptive learning may need to be re-read. Senge (1990) himself distinguishes adaptive learning from generative learning and emphasizes the advantages of the latter. However, in the context of digital pesantren technology, technology-based adaptive learning has a different meaning: it is not just survival learning, but an instrument to accelerate generative learning with more precise data. Thus, contemporary adaptive learning technology actually reinforces, not replaces, Senge's aspirations for generative learning. The practical implication of this discussion is that pesantren managers need to develop a digital transformation roadmap that combines four dimensions simultaneously, not sequentially. Kiai leadership must be transformed into learning leadership that guides students and ustadz in a culture of learning together. Training, infrastructure, curriculum, and governance must be aligned around a single vision: the pesantren as an adaptive, technology-based learning organization that remains rooted in Islamic scientific traditions.

The theoretical contribution of this article is the submission of the integrative framework of Senge-Adaptive Learning as a model for digital pesantren governance. The practical contribution is a four-dimensional guide that can be operationalized by pesantren managers. The limitation of this study is the attachment to the published literature, so it does not include innovative practices that have not been scientifically documented. Follow-up research can be conducted using a multi-site case study approach to empirically test this model.

D. Conclusion

This article has shown that students' digital transformation in Islamic boarding schools can be better understood when Peter Senge's concept of the learning organization is integrated with a technology-based adaptive learning approach. Using the Systematic Literature Review method, this study identified four key dimensions of transformation: modernization of data-based curriculum,

strengthening the digital capacity of ustadz and students, system-based governance of Islamic boarding schools, and preservation of Islamic values in the digital space. The four dimensions are proven to reinforce each other and together form a hybrid framework of Senge-Adaptive Learning which is proposed as a new theoretical contribution to the management of Islamic education. The main conclusion that can be drawn is that the pesantren that have succeeded in transforming digitally are pesantren that make collective learning a culture and personalize learning as a strategy, without losing the Islamic identity and heritage of its scientific traditions. Recommendations for further research include empirical testing of the Senge-Adaptive Learning model in various types of pesantren (salaf, khalaf, and combination), development of instruments for measuring the digital maturity of pesantren schools, as well as longitudinal studies on the impact of digital transformation on the competence of student graduates in the job market.

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