



Deep Learning-Based Intelligent Recommendation System and Management for Personalized Islamic Religious Education Materials

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ABSTRACT

Keywords:

Deep Learning,
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The purpose of this study is to examine the strategic role of information professionals in supporting digital transformation within educational institutions. Using a qualitative research design supported by a comprehensive literature review, this study analyzes how information professionals contribute to the planning, implementation, and sustainability of digital initiatives. The results reveal several major barriers to digital transformation, including limited budgets, resistance to change, inadequate skills, and insufficient technological infrastructure. Despite these challenges, information professionals serve as key change agents who promote innovation, improve administrative efficiency, and ensure stronger alignment between digital systems and institutional objectives. The findings imply that developing professional competencies, increasing digital literacy among stakeholders, and strengthening collaboration between information personnel and institutional leaders are essential for achieving sustainable digital transformation. This research contributes to a deeper understanding of human resource readiness for digital initiatives and offers practical insights for policymakers and educational leaders.

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INTRODUCTION

The rapid development of Artificial Intelligence (AI) has transformed various sectors, including education, where technology-driven personalization is increasingly viewed as essential for effective learning. As digital ecosystems evolve, students are no longer passive recipients of uniform instructional materials but require learning experiences that respond to their individual needs. This shift is supported by global frameworks such as UNESCO (2023), which emphasize that AI can enhance learning efficiency by up to 30% when used to

analyze real-time learning patterns (Byabazaire et al., 2025). The need for adaptive education is therefore not merely a technological trend but a societal requirement to ensure that learners receive equitable, tailored, and meaningful instruction. In Islamic educational contexts, this demand is even more pressing, given that learning should accommodate diverse cognitive, affective, and spiritual development. The integration of AI—specifically Deep Learning—thus represents an important response to societal needs, offering the potential to revolutionize personalized learning in ways that align with contemporary educational demands while supporting holistic human development.

Despite advancements in intelligent learning technologies, many educational institutions—particularly Islamic primary schools—continue to implement conventional and uniform teaching methods that fail to accommodate the diverse differences among students. Studies by Jasmansyah et al. (2025) and Kaya (2025) reveal that Islamic Religious Education (PAI) at the elementary level is predominantly teacher-centered, with instructional materials delivered in a standardized manner regardless of students' varying learning styles, interests, and abilities. This situation results in learning experiences that lack personalization, thereby reducing student engagement and limiting the effectiveness of instructional delivery. Teachers often struggle to design differentiated learning materials due to limited digital resources and time constraints, which further widens the gap between the ideals of personalized learning and the realities faced in classrooms. These challenges illustrate a fundamental problem: the inadequacy of current instructional models to support adaptive and meaningful learning in Islamic educational settings. Thus, there is a critical need for innovative technological approaches capable of addressing these persistent pedagogical limitations.

Preliminary observations and interviews conducted with PAI teachers at Madrasah Ibtidaiyah Raudlatul Jannah I Probolinggo indicate that approximately 72% of students display higher learning interest when instructional materials are adapted to their preferences, cognitive levels, and learning behaviors. However, the preparation of such differentiated materials continues to be carried out manually, requiring substantial time, effort, and pedagogical expertise from teachers. This manual process often leads to inconsistencies in material quality and delays in instructional delivery. Moreover, existing digital tools used at the school are limited to basic features and do not support data-driven personalization. Although the institution has demonstrated a commitment to technology-based learning transformation, the absence of intelligent recommendation systems prevents teachers from fully leveraging student learning behavior data. This situation highlights a critical gap between technological aspirations and practical implementation in madrasah

environments. It also signals the urgent necessity of employing AI-driven systems—specifically Deep Learning—to generate personalized PAI material recommendations automatically and efficiently.

Existing literature extensively documents the effectiveness of Deep Learning in various educational domains, particularly in generating accurate and adaptive learning recommendations. Suhartono (2022) and Prasetyo (2023) demonstrate that Deep Neural Networks can achieve up to 85% accuracy in predicting suitable learning materials within online learning platforms. Similarly, Zhao et al. (2022) note that Deep Learning–based systems can effectively analyze students’ interactive behavior to identify their preferences and adjust instructional content accordingly. However, the majority of these studies focus on science, mathematics, and language learning, leaving a significant gap in religious education contexts. This disciplinary imbalance indicates that the potential of Deep Learning to enrich Islamic Religious Education has not been fully explored, particularly in value-based learning contexts where cognitive, affective, and spiritual aspects are equally important. Consequently, while Deep Learning has shown strong potential in personalized education, its application in Islamic primary schools remains limited and requires deeper investigation.

A critical examination of previous studies further reveals that most AI-based educational research emphasizes algorithmic accuracy while overlooking pedagogical and spiritual dimensions, which are central to Islamic education (Kalip et al., 2025). As a result, existing systems fail to address the holistic developmental needs of madrasah students, who require learning approaches that integrate cognitive understanding with moral and spiritual growth. Furthermore, researchers rarely contextualize personalized learning frameworks within the local realities of Islamic schools, making the findings less applicable to environments such as MI Raudlatul Jannah I Probolinggo (Maisuroh et al., 2024; Aisyah et al., 2024). This gap highlights the necessity of developing a Deep Learning–based system specifically designed for Islamic educational values, such as *ta’dib* and *tazkiyah*, as proposed by Putro et al. (2024). Addressing these shortcomings is important not only to advance technological innovation but also to ensure that AI applications align with the spiritual goals and cultural contexts of Islamic education.

The novelty of this study lies in its integration of Deep Learning with Islamic educational values to produce a personalized recommendation system tailored to the needs of madrasah students. Unlike previous research that mainly targets general academic domains, this study situates intelligent systems within the context of Islamic Religious Education, where affective and spiritual dimensions are essential components of learning (Agbaria, 2024).

Methodologically, the study adopts a dual approach by combining computational Deep Learning analysis with pedagogical principles derived from Islamic educational philosophy, particularly the concepts of holistic development emphasized by Al-Attas (2018). This integration allows the system to analyze students' learning patterns—such as comprehension speed, engagement frequency, and topic preference—while ensuring that recommended materials support both academic progress and religious character formation. The state-of-the-art contribution of this research is its ability to bridge technological innovation with spiritual and cultural educational values, offering a model that is both technically sophisticated and pedagogically grounded.

This study seeks to address the core research problem: How can a Deep Learning-based recommendation system enhance personalized Islamic Religious Education in madrasah while aligning with Islamic values? The preliminary argument is that Deep Learning offers the computational capacity to analyze complex learning behavior data and generate adaptive material recommendations that support students' cognitive, affective, and spiritual development. By implementing this system at Madrasah Ibtidaiyah Raudlatul Jannah I Probolinggo, the study proposes that intelligent recommendations can significantly improve learning engagement, instructional relevance, and character formation. The research contributes theoretically by expanding the discourse on AI applications in value-based education, an area that remains understudied. Practically, it provides a model for Islamic schools to adopt AI without compromising their humanistic and spiritual missions. Ultimately, the study aims to establish a technologically enhanced learning environment that is both innovative and deeply rooted in Islamic educational principles.

RESEARCH METHOD

This study adopts a qualitative case study design aimed at exploring the implementation of Deep Learning in the development of an intelligent recommendation system for Islamic Religious Education (PAI) materials. The case study design was chosen because it allows for an in-depth understanding of a contemporary phenomenon within its real-life context, particularly when the boundaries between the phenomenon and the setting are not clearly defined (Risnita, 2024). Madrasah Ibtidaiyah Raudlatul Jannah I Probolinggo was selected as the research site due to its unique position as an Islamic elementary institution that has begun integrating AI-based technologies into its learning processes. The institution represents an ideal case, as it combines traditional religious learning with emerging digital innovations, making it suitable for examining how Deep Learning supports personalized PAI learning.

Data were collected through three primary techniques: in-depth interviews, direct observations, and documentation analysis. In-depth interviews were conducted with key informants involved in the implementation of the Deep Learning system, enabling the researcher to explore perceptions, experiences, and challenges from multiple perspectives. Direct observations captured the real-time interactions between students, teachers, and the recommendation system, while documentation analysis provided supporting data regarding system development and institutional policies. The respondents included school leaders, teachers, technology developers, and students, as detailed in Table 1.

Table 1. List of Respondents

NO	Respondent/Informant	Role
1	Madrasah Principal (KS)	Policy decision-maker and director of technological innovation in the madrasah
2	Islamic Religious Education Teacher (PI)	Primary implementer of the PAI material recommendation system
3	Technology Developer (Madrasah IT Team) (FA)	Designer and administrator of the Deep Learning system
4	Upper-Grade Students (Grades V–VI)	Direct users of the adaptive learning system
5	Vice Principal for Curriculum Affairs (AK)	Curriculum manager responsible for integrating Islamic values into the learning system

Data analysis was conducted using the Miles and Huberman model, which involves four interconnected stages: data condensation, data display, and conclusion verification. Data condensation was performed by selecting, simplifying, and categorizing relevant information; data display was conducted through thematic matrices to visualize relationships between findings; and verification was carried out continuously to ensure the credibility of emerging interpretations. To ensure data validity, source and technique triangulation were applied by comparing interview results with observational data and institutional documents (Dewi & SH, 2025). This triangulation process strengthened the trustworthiness of the findings and ensured that the analysis accurately reflected the real implementation of the Deep Learning–based recommendation system in the madrasah environment.

RESULT AND DISCUSSION

Deep Learning and Digital Transformation in Value-Based Islamic Education

The integration of Deep Learning at Madrasah Ibtidaiyah Raudlatul Jannah I Probolinggo functions not only as a technological innovation but also as

a strategic approach to digital transformation that reinforces Islamic values (Byabazaire et al., 2025). Interviews with the Principal (KS) and Vice Principal for Curriculum Affairs (AK) show that the system enhances instructional efficiency while aligning with the curriculum and spiritual objectives of the madrasah. This supports the concept of Technology Value Alignment, which emphasizes that educational technology achieves its potential only when harmonized with institutional culture, mission, and core values. The implementation illustrates that digital innovation can coexist with value-based education without compromising spiritual integrity.

From a critical perspective, maintaining this balance between technological sophistication and Islamic values requires continuous oversight. Although the system enhances efficiency and precision in recommending learning materials, it is crucial to monitor potential algorithmic biases and ensure that technological logic does not overshadow moral and spiritual education (Idoko, 2023). The adaptive features of Deep Learning allow personalized recommendations; however, the system alone cannot guarantee the holistic development of students if it is not guided by teachers' spiritual and pedagogical intuition.

The findings reveal that the Principal and Vice Principal actively mediate the alignment between AI-driven recommendations and religious values, demonstrating that leadership plays a key role in integrating technology within a value-based educational environment (Byabazaire et al., 2025). Nevertheless, the long-term sustainability of this alignment remains uncertain as the system evolves. Without continuous monitoring, there is a risk that the algorithm's technical focus could gradually diminish the emphasis on character formation, moral education, and spiritual development, core aspects of Islamic learning.

Finally, these results underscore the need for a reflective approach to digital transformation. The technology itself is not the ultimate goal; instead, it should serve as an instrument that enhances Islamic educational processes while respecting epistemological, ethical, and spiritual dimensions (Bolotio et al., 2022). Deep Learning thus becomes a facilitator of digital pedagogy that preserves the integrity of tazkiyah and character formation within PAI learning.

Enhancing Islamic Education with Deep Learning

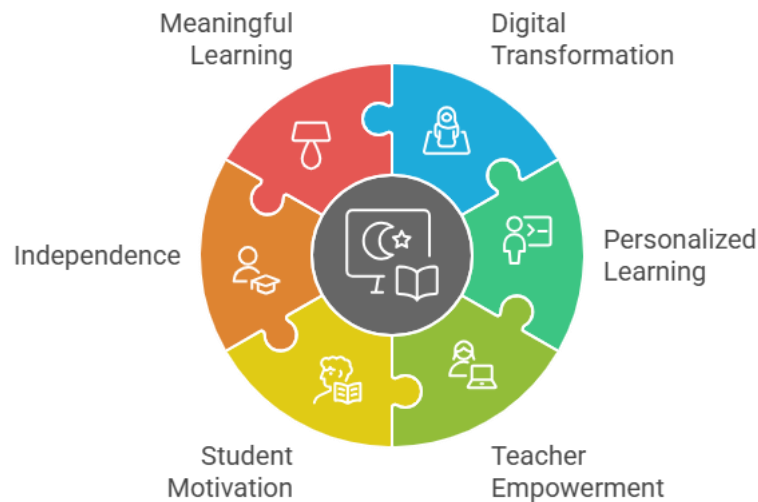


Figure 1 Enhancing Islamic Education with Deep Learning.

Deep Learning Enhances Personalized Learning and Teacher Roles in PAI

The system's ability to profile students' learning behaviors demonstrates its potential to strengthen personalized learning (Razum & Barudžija, 2023). By analyzing interaction patterns, comprehension speed, and learning preferences, the Deep Learning system enables teachers to tailor instructional content to individual student needs. This approach aligns with the Personalized Learning Ecosystem theory, which emphasizes holistic attention to cognitive, social, and emotional aspects. In the context of Islamic education, personalization must also accommodate spiritual growth, which requires teacher mediation to interpret algorithmic recommendations within moral and religious frameworks.

However, algorithm-driven personalization carries inherent epistemological limitations. While the system can capture observable behaviors, it cannot fully grasp deeper affective–spiritual dimensions such as intention, sincerity, or intrinsic religious motivation. This highlights the critical role of teachers as interpreters and mediators, ensuring that the algorithmic recommendations support holistic development rather than merely reflecting performance metrics (Salsabila, 2024). The integration of AI must therefore complement, not replace, teacher judgment.

Furthermore, the implementation reveals that AI can enhance teacher capacity, but this depends heavily on teachers' digital literacy and pedagogical understanding (Malla et al., 2023). Without sufficient competency, teachers risk over-reliance on system-generated recommendations, potentially diminishing

reflective teaching practices and critical judgment. Maintaining the teacher's authority in shaping learning experiences is essential, particularly in PAI learning, where spiritual guidance and moral exemplification are fundamental.

Finally, the findings suggest that Deep Learning can foster a collaborative dynamic between technology and pedagogy. Teachers become more informed about students' learning patterns, allowing for precise interventions while promoting autonomy and motivation (Nailasariy et al., 2023). Nevertheless, careful oversight is needed to prevent personalization from creating an "algorithmic comfort zone" that limits intellectual or spiritual challenge. The success of personalized learning thus depends on the balance between technological support and teacher-guided moral and cognitive development.

Deep Learning-Based Recommendation System Improves Students' Motivation, Independence, and Meaning in Learning

Students S1 and S2 reported increased motivation, independence, and engagement after interacting with the Deep Learning-based recommendation system (Mahmoud & Sørensen, 2024). By aligning learning materials with students' interests, preferences, and learning styles, the system facilitates autonomous study while enhancing understanding of PAI content. These experiences demonstrate the immediate impact of AI-driven personalization on intrinsic motivation, supporting the principles of Self-Determination Theory and Meaningful Learning Theory.

Nonetheless, the system's effectiveness must be critically examined beyond short-term engagement. Overly adaptive recommendations risk fostering dependency on preferred content, potentially reducing resilience and the capacity to engage with more challenging or less appealing topics, which are integral to tazkiyah and spiritual formation (Astuti et al., 2023). Therefore, while Deep Learning enhances motivation, teacher oversight remains essential to ensure that learning challenges and moral education are maintained.

Moreover, the system's capacity to offer multimedia and contextually relevant materials improves the relevance and meaning of PAI lessons (Salsabila, 2024). Students reported that videos, quizzes, and audio explanations not only enhanced understanding but also made learning enjoyable. However, the algorithm cannot fully capture the nuance of spiritual reflection, ethical reasoning, or collective learning experiences typical in pesantren-based education, indicating the necessity of integrating AI with human facilitation.

Finally, the findings confirm that Deep Learning has transformative potential in student-centered learning, provided it is implemented with attention to Islamic educational values and teacher mediation. The system becomes a tool to enhance engagement, motivation, and autonomy, while teachers retain responsibility for guiding moral and spiritual development, ensuring that technology serves education rather than substituting for human mentorship (Alam & Munawaroh, 2024).

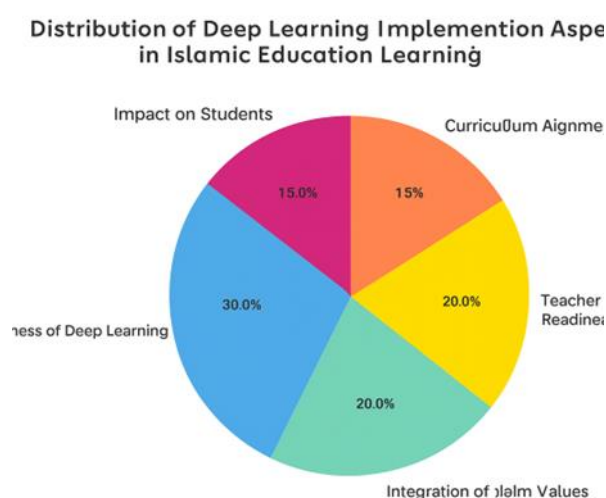


Figure 1.2 Effectiveness Of The Deep Learning System, Integration Of Islamic Values, Human Resource Readiness, Curriculum Suitability, And Impact On Students.

Integration of Curriculum, Human Resources, and Islamic Values

The integration of AI recommendations with curriculum objectives demonstrates that technological adoption need not conflict with national educational standards or religious values (Baharun & Diana, 2023). The Vice Principal for Curriculum Affairs ensures that all recommended materials align with Core and Basic Competencies (KI-KD) in Islamic Education while maintaining fidelity to Islamic pedagogy. This integration is crucial to prevent technological tools from deviating from educational goals and spiritual guidance.

Teacher and staff readiness emerged as a key factor in successful implementation. Interviews revealed that some teachers faced difficulties in understanding algorithmic outputs, emphasizing the need for ongoing training in digital literacy and AI comprehension (Salsabila, 2024). This highlights that human resources are as important as technology for achieving the desired educational impact.

Furthermore, the ethical and spiritual dimensions of system design were emphasized by both developers and educators. The system incorporates metrics for spiritual engagement, such as frequency of accessing moral, worship, or prophetic story content, ensuring that AI aligns with Islamic character development objectives (Alam & Munawaroh, 2024). Such design principles illustrate the potential for harmonizing technology with religious pedagogy without compromising moral or ethical standards.

Finally, the findings indicate that holistic implementation requires collaboration among developers, teachers, and curriculum experts. Sustainable AI adoption in PAI education demands continuous monitoring, evaluation, and refinement to maintain alignment between digital recommendations, pedagogy, and Islamic values. When successfully integrated, Deep Learning functions as both a pedagogical and spiritual instrument, enhancing personalized learning while safeguarding the essence of Islamic education (Astuti et al., 2023; Malla et al., 2023).

CONCLUSION

This study highlights that the application of Deep Learning in an intelligent recommendation system for Islamic Religious Education (PAI) materials provides significant insights into enhancing personalized, adaptive, and contextually relevant learning. The system effectively maps students' abilities, preferences, and learning styles, while integrating core Islamic values such as amanah, itqan, and ihsan. The key lesson from this research is that modern technology can harmoniously support tarbiyah Islamiyah principles, enabling teachers to act as spiritual facilitators and moral guides within a digital learning ecosystem. Practically, the system improves instructional efficiency, fosters learner autonomy, and strengthens the alignment between educational content and students' individual characteristics, offering a replicable model for other madrasahs seeking to integrate AI into Islamic education.

In terms of scholarly contribution, this study demonstrates how Artificial Intelligence can function as both a pedagogical and ethical tool, bridging the gap between technology and value-based education. Nonetheless, limitations remain: the research is confined to a single madrasah, teachers' digital literacy varies, and the long-term impact on students' moral and spiritual development has yet to be measured. Future research should expand the institutional scope, extend the implementation period, and integrate learning analytics with indicators of spiritual and moral growth. Strengthening collaboration among system developers, educators, and Islamic education experts will be crucial to ensure the sustainable, ethical, and humanistic application of AI in Islamic learning contexts.

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