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UTILIZATION OF ARTIFICIAL INTELLIGENCE, LEARNING ANALYTICS, AND BIG DATA IN ISLAMIC RELIGIOUS EDUCATION LEARNING

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Abstract

The digital transformation of the industry 4.0 era presents significant opportunities for Islamic Religious Education (PAI) through the utilization of Artificial Intelligence (AI), Learning Analytics (LA), and Big Data technologies. This article aims to examine the concepts, potentials, and integration strategies of these three technologies in PAI learning. This study employs a literature review approach, analyzing various scientific sources related to AI, LA, and Big Data in the context of Islamic education. The findings indicate that Big Data serves as the foundation for providing raw learning data, LA processes this data into meaningful information, while AI utilizes it for personalization and automation of learning. Their integration creates an adaptive, evidence-based, and individually responsive PAI learning ecosystem. This research contributes a conceptual framework for Islamic educational institutions in implementing digital technology without sacrificing the spiritual and humanistic values that constitute the essence of PAI.

INTRODUCTION

Digital transformation has brought fundamental changes in various aspects of human life, including in the field of Education (Sukardi, 2022). The Industrial Revolution 4.0 era marked by the convergence of digital, physical, and biological technologies presents new opportunities and challenges for the world of education, especially Islamic Religious Education (IRE). The rapid development of information and communication technology requires innovation in learning methods that are not only able to convey religious material effectively, but are also relevant to the needs of students in the digital era (Hasmiza, 2025).

Artificial Intelligence (AI), Learning Analytics (LA), and Big Data are the three pillars of technology that are now beginning to be integrated into the modern education system. AI with its ability to process information, recognize patterns,

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and provide adaptive recommendations has been proven to be able to improve the quality of learning by providing personalized content that meets the needs of each student (Nurhayati et al., 2024). Technologies such as machine learning, AI-based chatbots, and augmented reality (AR) are opening up new dimensions in more interactive and engaging learning.

Learning Analytics as a method of analyzing educational data provides a comprehensive picture of student conditions and the effectiveness of the overall learning process. Through LA, educational institutions can monitor student learning progress in real-time, identify students at risk of learning difficulties, and intervene in a timely manner (Baker & Inventado, 2024). Big Data in the context of education refers to the volume of big data generated from various learning activities, both online and offline, that can be collected and analyzed to produce in-depth insights.

The integration of these three technologies has enormous strategic potential. PAI as a subject that not only transfers knowledge but also shapes the character and spirituality of students, requires a learning approach that is able to touch the cognitive, affective, and psychomotor dimensions in a balanced manner. Research at MAN 1 Garut shows that the use of AI in PAI learning can help realize a learning process that is more directed, measurable, and relevant to the needs of students (Prasetyo, 2024).

The implementation of technology in PAI learning is very unfortunate to face various challenges. The problem of teachers' digital literacy, the limitation of technological infrastructure, the lack of special training, and ethical and theological issues are obstacles that need to be overcome. Previous research conducted by Rosyid (2024) focus on technical integration aspects, while Yusuf et al. (2022) Emphasizing more case studies in madrassas and Islamic boarding schools. The research gap that this research tries to fill is the availability of a comprehensive conceptual framework that connects the three technologies holistically in the context of PAI learning in the digital era.

This article aims to: (1) examine the concepts of AI, Learning Analytics, and Big Data in PAI learning; (2) analyze the integration patterns of the three

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technologies; and (3) identify the benefits of technology integration for students, teachers, and Islamic educational institutions. The urgency of this research is particularly relevant considering the need for Islamic educational institutions to adopt modern technology while maintaining the essence of Islamic values.

LITERATURE REVIEW

Artificial Intelligence

Artificial Intelligence (AI) is the ability of a computer system to perform tasks that typically require human intelligence, such as pattern recognition, learning from experience, decision-making, and problem-solving (Nurhayati et al., 2024). Conceptually, AI is defined as a multidisciplinary field that aims to automate activities that previously could only be performed by human intelligence (Pakpahan, 2021). AI does not simply function as a technical tool, but rather acts as an intelligent machine capable of analyzing data at scale, providing recommendations, and supporting more accurate decision-making in various areas of life, including education (Hendrian et al., 2024).

Learning Analytics

Learning Analytics (LA) is a systematic process that includes measuring, collecting, analyzing, and reporting data about learners and their learning context, with the aim of understanding and optimizing the learning process and environment in which learning takes place (Siemens & Long, 2024). LA is understood as the application of data analysis techniques in a structured manner to monitor, evaluate, and improve the effectiveness of the empirical evidence-based teaching and learning process (Hakim, 2025). LA can be positioned as a strategic bridge between Big Data analysis and decision-making in education, where the main goal is not just to collect and process data, but to utilize the results of the analysis to support decisions that improve the quality of students' learning experience in real terms (Baker & Inventado, 2024; Siregar & Musawaris, 2023).

Big Data

Big Data refers to data sets that are so large-scale, diverse, and generated at such a high speed that they require specialized technologies and analytical

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methods to extract the value and meaning contained in them (Siregar & Musawaris, 2023). The potential for the use of Big Data in education is very significant, ranging from monitoring student academic performance, curriculum adjustments, predicting learning failures, to increasing the effectiveness of overall management of educational institutions (Efgivia, 2020; Marlina et al., 2024).

RESEARCH METHOD

This research uses a qualitative approach with the type of literature study research (library research). The research was carried out throughout January-February 2026. The research object is the concept and implementation of AI, Learning Analytics, and Big Data in the context of Islamic Religious Education learning. Data were collected through literature searches from a variety of scientific sources, including indexed national and international journals, seminar proceedings, official government reports, and relevant textbooks. Source inclusion criteria: (1) published in the 2022-2025 range; (2) have relevance to the themes of AI, LA, Big Data, and PAI learning; (3) indexed in scientific databases such as SINTA, Scopus, or Google Scholar. The research instrument is in the form of a document analysis guide that covers aspects of definition, characteristics, potential, challenges, and implementation of technology in the context of Islamic education (Sugiyono, 2022). The data analysis technique uses content analysis with the following steps: (1) data reduction, namely the sorting of relevant sources; (2) the presentation of data in the form of descriptive-analytical descriptions; and (3) drawing conclusions based on the pattern of findings from the literature reviewed (Miles & Huberman, in Rosyid, 2024). The validity of the data is maintained through triangulation of sources by comparing findings from at least three different sources for each concept analyzed.

FINDINGS AND DISCUSSION

The Concept of Artificial Intelligence (AI) in PAI Learning

Artificial Intelligence (AI) is the ability of a computer system to perform tasks that typically require human intelligence, such as pattern recognition,

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learning from experience, decision-making, and problem-solving (Nurhayati et al., 2024). AI in the context of Education refers to the use of algorithms and computing technologies to automate the learning process, provide adaptive content, and provide personalized learning experiences.

Main characteristics of AI in education include: (a) personalization of learning based on student learning data analysis; (b) adaptivity that responds dynamically to student performance; (c) automation of administrative tasks such as assessment and scheduling; (d) predictive analysis to identify learning difficulties; and (e) improved accessibility for students in remote areas (Nurhayati et al., 2024). Some of the AI technologies that have been applied in the world of education include: Machine Learning that analyzes students' learning patterns (Abdullah, 2024), *Natural Language Processing* (NLP) to assess essay answers and facilitate translation of Arabic texts (Yusuf et al., 2022), AI-based chatbots as virtual assistants for learning, as well as Augmented Reality (AR) and Virtual Reality (VR) for Hajj simulation and Islamic history visualization.

The Concept of Learning Analytics (LA) in PAI Learning

Learning Analytics (LA) is the process of collecting, measuring, analyzing, and reporting data about learners with the aim of understanding and optimizing learning (Siemens & Long, 2024). LA can be understood as a bridge between Big Data analysis and strategic decision-making in education. The main components of LA include: (a) data collection from various sources such as LMS, e-learning platforms, and academic information systems; (b) measurement and analysis using statistics, data mining, and machine learning methods; (c) data visualization in the form of dashboards and graphs; and (d) interventions and recommendations based on the results of the analysis.

The analytical methods used include descriptive analytics, diagnostic analytics, predictive analytics, and prescriptive analytics. The application of LA in PAI can be used to monitor the progress of Qur'an memorization, analyze the understanding of religious concepts, identify at-risk students, evaluate the effectiveness of learning methods, and personalize learning paths (Ferguson, 2024).

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The Concept of Big Data in PAI Learning

Big Data refers to data sets in such large volumes, diverse, and generated at such a high speed that they require special technologies and analysis methods. The characteristics of Big Data are known as the 5V concept: Volume (very large amount of data), Velocity (speed of collection and processing), Variety (diversity of data types), Veracity (data accuracy), and Value (values and insights that can be extracted) (Suryantari et al., 2026).

Big Data used in PAI can be sourced from Learning Management Systems (LMS), digital Qur'an learning applications, academic information systems, learning video platforms, as well as social media and online forums. In Indonesia, the Dapodik (Basic Education Data) platform is an example of the application of Big Data that collects data on schools, teachers, and students nationally, including from madrasas and Islamic educational institutions (Kemendikbudristek, 2024).

Integrasi AI, Learning Analytics, dan Big Data dalam Pembelajaran PAI

The integration of these three technologies in PAI learning can be described as an interconnected digital ecosystem. Big Data serves as a foundation that provides raw data from various learning sources. LA processes Big Data into meaningful information through analysis, visualization, and interpretation. AI uses the results of the analysis from the LA to take automated actions such as adjusting learning content and providing recommendations (Rosyid, 2024).

The concrete implementation of this integration in PAI learning includes: (a) an adaptive learning system that creates a fully adaptive PAI environment; (b) dashboard monitoring for real-time visualization of student learning progress; (c) an intelligent PAI assistant chatbot that answers religious questions 24/7; (d) a data analysis-based PAI content recommendation system; and (e) a system of prediction and early intervention for at-risk students (Fauzi & Mahmud, 2024).

The results of the literature review confirm that the integration of AI, LA, and Big Data has great potential to transform PAI learning as a whole. These findings are in line with research Rosyid (2024) which shows that an integrated technology ecosystem is able to significantly improve the effectiveness and personalization of PAI learning.

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Benefits of Integration for Students

For students, technology integration provides personalized learning according to individual learning styles, flexible learning access anytime and anywhere, and instant and constructive feedback from AI systems. Gamification and AI-based interactive multimedia content have also been proven to increase student motivation and engagement with religious materials (Kusuma, 2025). Moreover, adaptive learning systems encourage the growth of learning independence, which is an important competency in the digital era.

Benefits of Integration for Teachers

For PAI teachers, the automation of administrative tasks through AI provides significant time and energy efficiency, so that teachers can focus more on aspects of character development and students' spirituality (A. Hakim, 2025). The LA-based analytics dashboard allows for real-time monitoring of the progress of the entire student and early detection of students who need special attention. These findings reinforce the argument Nurhadi & Sari (2024) that technology does not replace the role of teachers, but rather frees teachers from technical work to concentrate on the humanistic dimension of learning.

Benefits of Integration for Islamic Educational Institutions

At the institutional level, Big Data and LA enable empirical evidence-based decision-making in the management of Islamic educational institutions. Optimizing resources, increasing accountability, and strengthening institutional competitiveness are positive implications that can be felt. Data from various Islamic educational institutions can also be the basis for research on the development of a more adaptive and relevant PAI curriculum (Hidayat, 2024).

Implementation Limitations and Challenges

The implementation of the three technologies faces a number of limitations. First, the digital literacy gap between PAI teachers is still significant. Second, the technological infrastructure in many madrassas and Islamic boarding schools is inadequate. Third, there are theological concerns about over-reliance on technology that can reduce the spiritual dimension of learning. The balance between technological modernity and the humanistic-spiritual values of PAI is a

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major challenge that needs to be answered through comprehensive policies and training.

CONCLUSION

Based on the studies that have been conducted, it can be concluded that AI, Learning Analytics, and Big Data are three interrelated technologies that can be integrated to create a more effective, adaptive, and data-based PAI learning ecosystem. Big Data serves as the foundation of raw data providers, LA processes that data into meaningful information, while AI leverages it to personalize content and automate the learning process.

The integration of all three provides tangible benefits for students (personalized learning and flexible access), teachers (time efficiency and decision-making data), and Islamic educational institutions (evidence-based policies and quality improvement). This research has limitations in terms of the absence of empirical tests of implementation in the field, so further research is recommended using experimental approaches or case studies in madrassas and pesantren to validate the proposed conceptual framework. In the end, the use of AI, Learning Analytics, and Big Data in PAI learning is not just the adoption of technology, but is a learning transformation that maintains a balance between modernity and tradition, between technology and humanity, between innovation and Islamic spirituality.

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