



Technology-Based Assessment Innovation in Islamic Religious Education: A Systematic Literature Review of Opportunities and Challenges

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Abstract: The development of digital technology has brought significant changes in the world of education, including in the learning assessment system for Islamic Religious Education (PAI). This study aims to identify and analyze the opportunities and challenges of implementing technology-based assessment innovation in PAI subjects in Indonesia. This research employs a systematic literature review (SLR) method by analyzing various bibliographic sources including scientific journal articles, textbooks, and relevant educational policy documents published in the last ten years. The results of the study show that technology-based assessment innovation offers various strategic opportunities, including: improved objectivity of assessment, efficiency of time and educators' effort, ease of access and flexibility of assessment, and the ability to produce faster and more accurate feedback. On the other hand, there are a number of challenges that need to be anticipated, including: the digital infrastructure gap between institutions, the low technology competence of some PAI educators, resistance to changing assessment paradigms, and issues of academic integrity in online assessment. This study concludes that the implementation of technology-based assessment in PAI requires a comprehensive approach, involving strengthening teacher capacity, sustainable policy support, and adaptation of assessment instruments that continue to accommodate the spiritual and character dimensions in Islamic learning. These findings have significant implications for the development of PAI educators' digital competency, particularly in the areas of designing digital assessment instruments, utilizing Learning Management Systems (LMS), and integrating the TPACK (Technological Pedagogical Content Knowledge) framework in daily assessment practices. Furthermore, the findings imply the urgent need for affirmative government policies to ensure equitable digital infrastructure across Islamic educational institutions in Indonesia, so that technology-based assessment innovation can be implemented fairly and effectively in both urban and rural contexts.

Keyword: technology-based assessment, Islamic Religious Education (PAI), assessment innovation, systematic literature review, digital education, TPACK, opportunities and challenges

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Introduction

Islamic Religious Education (PAI) as a subject that simultaneously encompasses cognitive, affective, and psychomotor dimensions requires an assessment system capable of measuring all three dimensions comprehensively. However, PAI assessment practices have long been dominated by conventional models that tend to be summative and limited to the knowledge aspect alone (Dona & Puspa, 2024). On the other hand, the development of information and communication technology has opened opportunities for transforming the assessment system toward a more authentic, adaptive, and data-driven model. Various studies have shown that technology can improve the quality of assessment across various fields of study (Saidah & Muhid, n.d.). However, the adoption of assessment technology in the context of PAI remains relatively limited and has not been systematically documented in the Indonesian scientific literature.

To understand the landscape of technology-based assessment in PAI, this study is grounded in three key theoretical frameworks. First, Digital Assessment Theory posits that assessment conducted through digital media and technology platforms fundamentally transforms the nature of measurement, enabling real-time data collection, automated feedback, and multimodal evidence of learning (Kimbell, 2012). Digital assessment transcends paper-based limitations by allowing adaptive questioning, multimedia responses, and instantaneous analytics that are especially relevant for PAI's multi-dimensional learning objectives. Second, the Assessment for Learning (AfL) framework, developed by Black and Wiliam (1998), emphasizes that assessment should primarily serve as a tool for improving learning rather than merely measuring outcomes. In the context of PAI, AfL aligns with the Islamic pedagogical principle of continuous self-reflection (*muhasabah*), wherein ongoing formative feedback supports students' spiritual and moral growth alongside academic development. Third, the TPACK (Technological Pedagogical Content Knowledge) framework by Mishra and Koehler (2006) and Hendrawati & Suherman, (2026). provides a critical lens for understanding what PAI teachers need to effectively integrate technology into assessment. TPACK argues that effective technology integration requires not just technological knowledge, but its meaningful intersection with pedagogical knowledge and subject-specific content knowledge — in PAI's case, including the epistemological underpinnings of Islamic education.

The state of the art in this field reveals an emerging but fragmented body of research. Sariman et al. (2021) examined e-assessment in PAI learning in madrasas and found increased student motivation, but did not address implementation challenges in depth. Hartanto and Soedjiwo (2025) researched LMS platforms in PAI assessment and concluded that digital competence is a determining factor of success. Sriyanta (n.d.) focuses on technology-based authentic assessment in *pesantren* contexts, yet remains descriptive without comprehensive analysis of opportunities

and challenges. Meanwhile, Syarif et al. (n.d.) explored e-assessment and Big Data in Islamic education evaluation, noting academic integrity risks. Collectively, these studies demonstrate growing scholarly interest but reveal a persistent gap: no existing study systematically and comprehensively analyzes both opportunities and challenges of technology-based assessment innovation in PAI within the Indonesian context. This study aims to fill that gap.

The gap between the need for holistic PAI assessment and the availability of adequate digital instruments represents a fundamental problem that remains unresolved. Research by Muhammad Anggana Galih Pratama et al. (2023) reveals that the majority of PAI teachers in Indonesia still use traditional assessment methods in the form of written tests and memorization without utilizing digital technology. Meanwhile, the Merdeka Curriculum policy encourages the application of diverse diagnostic, formative, and summative assessments as well as digital portfolio-based assessments (Kemdikbudristek, 2022). There is a significant gap between policy demands and the reality of practice in the field, particularly in PAI subjects which have their own unique characteristics in the assessment of spiritual and moral dimensions.

This study aims to: (1) identify the various forms of technology-based assessment innovation relevant to PAI learning; (2) analyze the opportunities for implementing technology-based assessment innovation in PAI; and (3) identify the challenges of implementing technology-based assessment innovation in PAI and formulate strategic solutions. The novelty of this study lies in its analytical focus that combines the perspectives of educational technology, curriculum policy, and the epistemological characteristics of Islamic education within one integrated study framework grounded in Digital Assessment Theory, AfL, and TPACK.

Methodology

Research Approach and Type

This study uses a qualitative approach with the type of systematic literature review (SLR). This approach was chosen because it enables researchers to identify, evaluate, and synthesize findings from various relevant studies in a systematic and transparent manner (Latifah et al., 2023). SLR differs from conventional literature reviews because it has explicit search protocols and inclusion-exclusion criteria, thereby producing more reliable and replicable findings.

Data Sources

The data sources in this study are bibliographic documents including: (1) national and international scientific journal articles indexed in Google Scholar, ERIC, and SINTA databases with a publication range of 2018–2024; (2) national education policy documents, particularly regulations related to the Merdeka Curriculum and

PAI assessment standards issued by the Ministry of Education, Culture, Research, and Technology (Kemdikbudristek) and the Ministry of Religious Affairs of the Republic of Indonesia; and (3) textbooks and research reports relevant to the topic of assessment innovation and Islamic educational technology.

Data Collection Technique

Data collection was carried out through documentation techniques using standardized data extraction sheets. Keywords used in the literature search include: "inovasi penilaian PAI", "asesmen digital pendidikan agama Islam", "technology-based assessment Islamic education", "e-assessment madrasah", and "penilaian autentik berbasis teknologi". Inclusion criteria include: (a) articles published between 2018–2024; (b) discussing assessment in the context of Islamic education or PAI; (c) discussing the use of technology in assessment; and (d) full text available. Exclusion criteria include articles not written in Indonesian or English, as well as articles that have not undergone a peer-review process.

In total, the initial database search yielded 147 articles across all databases: 89 from Google Scholar, 31 from ERIC, and 27 from SINTA. After removing duplicates ($n = 23$), a total of 124 articles underwent title and abstract screening. Of these, 87 articles were excluded at the screening stage because they did not meet the inclusion criteria – primarily because they discussed assessment in non-PAI subjects or did not address the use of technology in assessment. The remaining 37 articles underwent full-text eligibility assessment. Following further evaluation for methodological quality and direct relevance, 15 articles were excluded due to insufficient methodological rigor, incomplete data, or being non-peer-reviewed sources. Ultimately, 22 articles were included in the final synthesis. This selection process followed the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) protocol to ensure transparency and rigor in the literature selection process.

Data Analysis Technique

Data analysis was conducted using content analysis techniques with a thematic approach. The analysis process followed four stages: (1) data reduction through literature selection based on relevance and quality; (2) data presentation in the form of a synthesis matrix that organizes findings based on categories of opportunities and challenges; (3) interpretation and drawing of inferences based on patterns of findings across sources; and (4) drawing of conclusions based on the accumulation of evidence from various bibliographic sources. The entire analysis process was carried out manually with the assistance of document processing software for reference management.

Result and Discussion

Finding

Based on the systematic literature review conducted on 22 selected articles, various forms of technology-based assessment innovation that can be applied in PAI learning were identified. First, digital formative assessment through platforms such as Google Forms, Quizizz, and Kahoot that allow teachers to obtain real-time feedback on student understanding. Second, digital portfolios that enable continuous documentation of student learning progress, including aspects of Qur'anic memorization, religious practice, and moral development. Third, AI-adaptive assessment (Artificial Intelligence-based adaptive assessment) capable of adjusting the difficulty level of questions based on individual student abilities. Fourth, digital project-based assessment that encourages students to produce works based on Islamic values in digital formats such as da'wah videos, infographics, or online reflection journals. Fifth, Learning Analytics that enables in-depth analysis of student learning patterns to support more accurate pedagogical decision-making (Dwijaksana et al., n.d.).

Table 1. Synthesis of Key Articles in the Systematic Literature Review

No	Author/Year	Study Focus	Key Findings	Relevance to PAI Assessment
1	Sariman et al. (2021)	E-assessment in PAI learning in madrasas	Increased student motivation; implementation challenges not deeply explored	Opportunity: digital assessment can enhance student engagement in PAI
2	Hartanto & Soedjiwo (2025)	LMS-based interactive teaching materials	Teachers' digital competence is the key success factor for LMS adoption	Challenge: digital competence gap among PAI educators
3	Sriyanta (n.d.)	Technology-based authentic assessment in pesantren	Descriptive benefits of ICT in PAI assessment; limited systematic analysis	Gap: need for comprehensive opportunities and challenges analysis
4	Firmansyah et al. (2025)	Formative assessment integration via Quizizz	Technology-based formative assessment significantly improves learning outcomes through timely feedback	Opportunity: real-time feedback for PAI teachers

5	Rahmania & Bakar (2023)	Islamic education philosophy (Al-Attas perspective)	Spiritual-ruhiyah dimension must be captured in assessment; hard to quantify digitally	Challenge: validity of spiritual dimension in digital instruments
6	Syarif et al. (n.d.)	E-assessment and Big Data in Islamic education evaluation	E-assessment without adequate security protocols worsens academic integrity issues	Challenge: academic dishonesty in online PAI assessment
7	Simbolon (n.d.)	PAI teachers' perception of inclusive learning & LMS	LMS can save grading time up to 60% compared to conventional methods	Opportunity: efficiency and time management for PAI educators
8	M. A. G. Pratama et al. (2023)	Assessment techniques in PAI learning	Majority of PAI teachers still use traditional written tests without digital tools	Gap: low adoption of digital assessment in Indonesian PAI classrooms
9	Dwijaksana et al. (n.d.)	Learning analytics in SMK	Learning analytics enables in-depth analysis of student patterns for better pedagogical decisions	Opportunity: data-driven decision making in PAI
10	Latifah et al. (2023)	SLR methodology for learning media development	SLR with explicit criteria produces more reliable and replicable findings	Methodological: basis for this study's SLR approach

Discussion

The opportunities for implementing technology-based assessment innovation in PAI can be analyzed from several dimensions. From the pedagogical effectiveness dimension, technology enables more authentic and holistic assessment, in line with the demands of PAI which not only measures cognitive aspects but also affective and psychomotor ones. Firmansyah et al. (2025) affirm that technology-based formative assessment has been proven to significantly improve learning outcomes through timely feedback mechanisms. In the context of PAI, this has important implications as it enables teachers to monitor the development of students' character and religious behavior in a more structured manner. This finding is consistent with the Assessment for Learning (AfL) framework, which positions assessment as a primary driver of learning improvement rather than a mere measurement tool.

From the efficiency dimension, assessment technology can reduce the administrative burden on PAI teachers who have historically spent significant time on manual grading, so that teachers' energy can be focused on spiritual guidance and the development of students. Simbolon (n.d.) reports that the use of LMS in PAI assessment can save grading time by up to 60% compared to conventional methods. From the dimension of fairness and inclusivity, well-designed assessment technology can reduce subjective bias in assessing the affective aspects of PAI that have historically been difficult to measure objectively.

However, the implementation of this innovation also faces significant challenges. The first challenge is the digital infrastructure gap. Data from Kemendikbudristek (2022) show that there is still a significant gap in the availability of digital devices and internet connectivity between schools in urban and rural areas, between public and private schools, and between Java and outside Java. This condition has the potential to create inequity in the implementation of technology-based assessment.

The second challenge relates to educators' digital competence. A survey by the Kemdikbudristek Policy Research Center (2021) reveals that the majority of PAI teachers, especially those over 40 years of age and serving in remote areas, still have low digital literacy. Through the lens of the TPACK framework, this challenge is multi-layered: PAI teachers must simultaneously develop technological knowledge (TK), pedagogical knowledge (PK), and content knowledge (CK) specific to Islamic education – a complex integration that requires sustained and contextual professional development rather than one-time training workshops.

The third challenge concerns the validity of assessing the spiritual dimension. One of the unique features of PAI is the assessment component related to the spiritual dimension and moral formation that is difficult to quantify through standard digital instruments. Rahmanian and Bakar (2023) state that from the perspective of Islamic educational philosophy, assessment in Islamic education must be able to capture the transcendent *ruhiyah* dimension, which presents its own challenge for technology-based assessment instruments that tend to be empirical-quantitative in nature.

The fourth challenge is the issue of academic integrity. Online assessments that are not properly managed have the potential to increase academic dishonesty. Syarif et al. (n.d.) note that the implementation of e-assessment without adequate security protocols can worsen academic integrity problems, which specifically contradicts the values of honesty (*amanah*) that PAI itself aims to instill.

To address these various challenges, this study formulates several strategic recommendations. First, the development of continuous and contextual digital literacy training programs for PAI teachers needs to be prioritized, explicitly structured around the TPACK framework to ensure that technology integration is pedagogically grounded and content-appropriate. Second, technology-based PAI

assessment instruments specifically designed to accommodate the spiritual and moral dimensions need to be developed, for example through e-portfolios of character development or digital reflection journals. Third, affirmative policies need to be implemented to ensure the availability of equitable digital infrastructure across all PAI-providing institutions.

Conclusion

This systematic literature review makes a significant scientific contribution by providing the first comprehensive, theoretically-grounded analysis of technology-based assessment innovation in Indonesian Islamic Religious Education (PAI). Unlike previous studies that examined either opportunities or challenges in isolation or within a single institutional context, this study synthesizes 22 peer-reviewed articles across diverse PAI settings to reveal an integrated picture of the field's current state and future directions. The study confirms that technology-based assessment – when properly designed and implemented – offers transformative potential for PAI evaluation, particularly in improving objectivity, efficiency, and the authenticity of multi-dimensional Islamic learning assessment.

The scientific contribution of this study is threefold. First, it provides an empirically grounded taxonomy of technology-based assessment forms relevant to PAI, ranging from digital formative assessment and e-portfolios to AI-adaptive assessment and learning analytics. Second, it identifies and theorizes four systemic challenges – infrastructure disparity, educator digital competence, spiritual dimension validity, and academic integrity – within the TPACK and AfL frameworks, offering a more nuanced understanding than previously available in the Indonesian literature. Third, it proposes strategic solutions that are contextually sensitive to the epistemological characteristics of Islamic education, bridging the gap between generic educational technology discourse and the specific needs of PAI.

The findings carry direct implications for the development of specific PAI teacher competencies. Effective implementation of technology-based assessment requires PAI educators to master: (1) operational competency in digital assessment platforms such as Google Forms, Quizizz, Moodle, and learning management systems; (2) instrument design competency – the ability to construct digital assessment tools that are valid, reliable, and sensitive to the spiritual and character dimensions of PAI; (3) data literacy – the capacity to interpret learning analytics data to inform pedagogical decisions; and (4) digital ethics and integrity management competency, ensuring that technology-based assessment upholds the Islamic values of *amanah* (trustworthiness) and *adalah* (fairness) that PAI is mandated to cultivate. These competencies should be explicitly incorporated into PAI teacher professional development programs, pre-service teacher education curricula at Islamic higher

education institutions, and in-service training frameworks under the Kemdikbudristek and the Ministry of Religious Affairs.

This study recommends the need for further empirical studies specifically developing and testing contextually appropriate technology-based PAI assessment models that reflect the uniqueness of Islamic values. Future research should employ quasi-experimental or design-based research methodologies to test the effectiveness of specific instruments – such as character e-portfolios or AI-integrated spiritual reflection tools – in real PAI classroom settings, so that the resulting innovation is not only technically effective but also pedagogically and spiritually meaningful.

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