

**GENERATIVE AI, HUMAN AI COLLABORATION, AND
LEARNING ANALYTICS: A RESPONSIBLE ASSESSMENT
FRAMEWORK FOR INFORMATICS EDUCATION IN ISLAMIC
HIGHER EDUCATION**

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Keywords:	Abstract
Generative Artificial Intelligence, Human AI Collaboration, Learning Analytics, Informatics Education, Responsible Assessment	The rapid adoption of Generative Artificial Intelligence (GenAI) has transformed assessment practices in informatics education, enabling adaptive feedback, automated evaluation, and personalized learning. However, existing assessment models often emphasize technological efficiency while overlooking ethical responsibility, human collaboration, and academic integrity. This conceptual study aims to develop a Responsible Assessment Framework integrating Generative AI, Human AI Collaboration, and Learning Analytics within the context of Islamic higher education. Using a qualitative library research approach, the study synthesizes contemporary literature on AI in education, educational assessment, learning analytics, informatics education, and Islamic educational philosophy. The proposed framework comprises five interconnected dimensions: responsible AI use, Human AI collaborative assessment, learning analytics, informatics competency assessment, and Islamic ethical values. The framework promotes transparent, accountable, and human-centered assessment while strengthening digital competence, critical thinking, ethical decision-making, and academic integrity. It offers a sustainable conceptual model for future assessment in informatics education within Islamic higher education.

INTRODUCTION

The rapid advancement of **Generative Artificial Intelligence (GenAI)** has significantly reshaped teaching, learning, and assessment practices in higher education. In informatics education, AI-powered technologies such as large language models, intelligent tutoring systems, automated programming assistants, and adaptive learning platforms have become integral components of the learning process. These technologies enable students to generate programming code, analyze datasets, solve computational problems, and receive immediate feedback, thereby improving learning efficiency and personalization. Consequently, educational assessment is shifting from conventional examinations toward continuous, competency-based, and technology-enhanced evaluation that reflects students' authentic learning experiences. This transformation presents opportunities for more effective assessment while simultaneously raising important pedagogical and ethical questions (Harifah & Sofa, 2025).

Despite these opportunities, the integration of GenAI into assessment has generated significant concerns regarding academic integrity, originality, transparency, and the reliability of AI-assisted learning outcomes. Students increasingly rely on AI to complete assignments, making it difficult for educators to distinguish between genuine competencies and AI-generated products. Furthermore, issues such as algorithmic bias, data privacy, explainability, and responsible AI use have become central discussions in educational technology research. These challenges are particularly relevant in **informatics education**, where graduates are expected to master computational thinking, programming, artificial intelligence literacy, cybersecurity awareness, and data literacy while demonstrating ethical responsibility in the development and application of digital technologies. Therefore, assessment frameworks must evolve to evaluate not only technical competence but also students' ability to use AI critically, responsibly, and collaboratively (Sholeha & Sofa, 2025).

Recent developments in educational research highlight the importance of **Human–AI Collaboration** and **Learning Analytics** as complementary approaches for improving assessment quality. Human–AI Collaboration emphasizes that artificial intelligence should augment rather than replace human intelligence, allowing students and educators to work collaboratively with AI in problem-solving, creativity, and decision-making. Meanwhile, Learning Analytics enables institutions to collect and analyze educational data to monitor learning progress, identify competency gaps, and provide personalized feedback. However, these technological innovations should be implemented within a **human-centered educational paradigm** that prioritizes learner autonomy, fairness, transparency, and ethical governance. In the context of Islamic higher education, these principles are reinforced by Islamic ethical values such as *amanah* (trustworthiness), *'adl* (justice), *ihsan* (excellence), and *maslahah* (public benefit), ensuring that technological advancement remains aligned with moral and educational objectives (F. Mardiyah & Sofa, 2025).

Although numerous studies have explored Generative AI, AI literacy, Learning Analytics, and digital assessment independently, relatively limited research has integrated these perspectives into a comprehensive assessment framework specifically for informatics education in Islamic higher education. Existing assessment models tend to emphasize technological performance without sufficiently incorporating ethical responsibility, collaborative intelligence, and Islamic educational values. Therefore, this study aims to develop a Responsible Assessment Framework that integrates Generative AI, Human–AI Collaboration, and Learning Analytics to support competency-based assessment in informatics education. The proposed framework contributes to the growing discourse on AI-supported assessment by offering a holistic model that balances technological innovation, human collaboration, academic integrity, and ethical values, thereby supporting sustainable and responsible digital transformation in Islamic higher education (Shalawati & Sofa, 2025).

LITERATURE REVIEW

The rapid advancement of Generative Artificial Intelligence (GenAI) has introduced a new paradigm in educational assessment, particularly in informatics education. Unlike traditional digital technologies, GenAI can generate programming code, textual explanations, multimedia content, and problem-solving strategies that support students' learning processes. Recent studies have shown that GenAI enhances

adaptive assessment, automated feedback, intelligent tutoring, and personalized learning experiences. However, the increasing use of AI in education also raises concerns regarding academic integrity, originality, transparency, and students' overreliance on AI-generated outputs. Consequently, scholars argue that assessment should move beyond evaluating final products and instead examine learners' reasoning processes, problem-solving strategies, and responsible use of artificial intelligence (Sofa, 2026).

The concepts of **Human–AI Collaboration** and **Learning Analytics** have emerged as complementary approaches for designing more effective and evidence-based assessment systems. Human–AI Collaboration emphasizes the complementary roles of humans and AI, where artificial intelligence provides computational efficiency, automated feedback, and data processing, while learners contribute critical thinking, creativity, ethical judgment, and contextual decision-making. Simultaneously, Learning Analytics utilizes educational data to monitor student engagement, predict academic performance, identify learning difficulties, and provide personalized interventions. The integration of these approaches supports continuous, competency-based assessment while maintaining educators' central role in interpreting learning evidence and guiding students' intellectual development. Together, they establish a more adaptive and learner-centered assessment environment suited to the demands of twenty-first-century informatics education (Nadia & Sofa, 2025).

Within **Islamic higher education**, assessment is expected to evaluate not only cognitive and technical competencies but also ethical behavior, academic integrity, and social responsibility. Islamic educational philosophy emphasizes values such as *amanah* (trustworthiness), *'adl* (justice), *ihsan* (excellence), *sidq* (honesty), and *maslahah* (public benefit), which provide ethical guidance for the responsible application of artificial intelligence in education. Nevertheless, existing studies have rarely integrated **Generative AI, Human–AI Collaboration, Learning Analytics, and Islamic ethical values** into a unified assessment framework for informatics education (A. Mardiyah & Sofa, 2025). This conceptual gap provides the foundation for the present study, which proposes a responsible assessment framework that aligns technological innovation with human-centered learning and the ethical objectives of Islamic higher education.

RESEARCH METHODS

This study employed a **qualitative library research** design to develop a conceptual framework for responsible assessment integrating **Generative Artificial Intelligence (GenAI), Human–AI Collaboration, and Learning Analytics** in informatics education within Islamic higher education. The library research approach was selected because the study focused on critically examining and synthesizing existing theories, empirical findings, and conceptual models rather than collecting primary field data. The analysis aimed to identify the interrelationships among artificial intelligence, educational assessment, informatics competencies, learning analytics, and Islamic educational values to formulate a comprehensive assessment framework (Sofa, 2026).

The data sources consisted of **primary** and **secondary** literature. Primary sources included seminal works on educational assessment, Artificial Intelligence in Education (AIED), Human–AI Collaboration, Learning Analytics, and Islamic educational philosophy. Secondary sources comprised peer-reviewed journal articles, academic books, conference proceedings, policy reports, and international frameworks related to AI literacy, digital competence, competency-based assessment, and responsible AI. To

ensure the relevance of the proposed framework, priority was given to recent publications from reputable international journals indexed in major scholarly databases (Sa'diya et al., 2026).

The collected data were analyzed using **qualitative content analysis** based on the interactive model of **Miles, Huberman, and Saldaña**, consisting of **data condensation, data display, and conclusion drawing/verification**. The analysis focused on identifying recurring concepts, theoretical relationships, and emerging themes concerning responsible AI assessment in informatics education. To enhance the credibility and trustworthiness of the findings, **source triangulation** was conducted by comparing perspectives across educational technology, informatics education, learning analytics, artificial intelligence, and Islamic education literature. The synthesis of these sources resulted in the development of a conceptual **Responsible Assessment Framework** that integrates technological innovation with ethical principles and human-centered learning in Islamic higher education.

RESULTS AND DISCUSSION

The analysis of the reviewed literature indicates that Generative Artificial Intelligence (GenAI) has fundamentally transformed assessment practices in informatics education by shifting evaluation from static, summative examinations toward continuous, adaptive, and competency-based assessment. AI-powered systems provide automated feedback, intelligent code evaluation, personalized learning recommendations, and real-time monitoring of students' academic progress. These capabilities enable lecturers to assess not only learning outcomes but also students' problem-solving processes and competency development throughout the learning cycle. Nevertheless, the literature consistently emphasizes that AI-generated responses cannot be considered direct evidence of students' mastery. Instead, assessment should focus on students' ability to formulate effective prompts, critically evaluate AI-generated outputs, verify information, and demonstrate independent reasoning. This transformation reflects the growing importance of authentic assessment that measures higher-order thinking rather than simple content reproduction (Qomariah et al., 2026).

The findings further reveal that Human–AI Collaboration constitutes a new assessment paradigm in informatics education. Rather than replacing educators or learners, artificial intelligence functions as a collaborative partner that enhances computational efficiency, automates routine tasks, and supports knowledge exploration. Meanwhile, students remain responsible for interpreting AI-generated information, validating computational results, solving authentic problems, and making ethical decisions. Consequently, responsible assessment should evaluate collaborative intelligence by measuring students' computational thinking, creativity, critical reflection, communication skills, and responsible AI utilization. Such an approach recognizes that future informatics professionals must possess not only technical expertise but also the capacity to collaborate effectively with intelligent technologies in solving complex real-world problems. Therefore, Human–AI Collaboration extends assessment beyond technical competence toward the evaluation of cognitive, metacognitive, and collaborative capabilities (Zainal & Sofa, 2026).

The literature synthesis also identifies Learning Analytics as a strategic mechanism for supporting intelligent and evidence-based assessment. By collecting and analyzing learner-generated data, learning analytics enables educators to monitor

participation, identify competency gaps, predict academic achievement, and design personalized interventions. The integration of learning analytics with Generative AI further enhances adaptive assessment through real-time feedback and individualized learning pathways. However, scholars consistently emphasize that data-driven assessment must adhere to the principles of transparency, accountability, privacy protection, and algorithmic fairness. Within Islamic higher education, these principles correspond to Islamic ethical values such as *amanah* (trustworthiness), *ṣidq* (honesty), *'adl* (justice), and *ihsan* (excellence), ensuring that educational technologies are implemented responsibly and remain oriented toward human welfare. Thus, learning analytics should serve as a decision-support system that complements educators' professional judgment rather than replacing human evaluation.

Based on the integration of contemporary literature, this study proposes a **Responsible Assessment Framework** for informatics education in Islamic higher education comprising **five interconnected dimensions**. The first dimension, **Responsible AI Utilization**, ensures that Generative AI is employed transparently, ethically, and accountably throughout the assessment process. The second dimension, **Human–AI Collaborative Assessment**, evaluates learners' ability to work effectively with AI while maintaining critical thinking and independent judgment. The third dimension, **Learning Analytics**, utilizes educational data to provide continuous, evidence-based, and personalized assessment. The fourth dimension, **Informatics Competency Assessment**, measures computational thinking, programming proficiency, AI literacy, data literacy, cybersecurity awareness, and digital problem-solving. The fifth dimension, **Islamic Ethical Values**, evaluates academic integrity, ethical responsibility, digital citizenship, and moral decision-making grounded in Islamic educational philosophy (Helmi & Sofa, 2025). Collectively, these dimensions establish a holistic assessment model that integrates technological innovation with human-centered learning and ethical governance. The proposed framework contributes conceptually by extending existing digital assessment models toward a sustainable assessment paradigm that prepares graduates to become competent, responsible, and ethically grounded professionals in the era of Generative Artificial Intelligence.

CONCLUSION

The rapid development of **Generative Artificial Intelligence (GenAI)** has transformed assessment practices in informatics education, requiring a shift from conventional evaluation toward intelligent, competency-based, and continuous assessment. The findings of this conceptual study demonstrate that effective assessment should extend beyond measuring cognitive achievement to evaluate students' ability to collaborate with AI, apply computational thinking, utilize digital technologies responsibly, and maintain academic integrity. Accordingly, assessment in Islamic higher education should balance technological innovation with human-centered learning and ethical responsibility to ensure that AI enhances, rather than replaces, meaningful educational processes (Sukandarman & Sofa, 2024).

This study proposes a **Responsible Assessment Framework** that integrates **Generative AI, Human–AI Collaboration, Learning Analytics, Informatics Competency Assessment, and Islamic Ethical Values** into a unified conceptual model. The framework provides a holistic approach to assessment by combining adaptive AI technologies with evidence-based learning analytics, competency-oriented evaluation,

and Islamic ethical principles such as *amanah* (trustworthiness), *'adl* (justice), *ihsan* (excellence), and *sidq* (honesty). This integration enables assessment to capture not only students' technical competencies but also their critical thinking, ethical decision-making, digital responsibility, and collaborative intelligence, thereby supporting the development of future-ready graduates equipped for the digital era (Ichsan et al., 2026).

The proposed framework contributes to the advancement of educational assessment theory by bridging contemporary developments in Artificial Intelligence in Education (AIED), learning analytics, and informatics education with the philosophical foundations of Islamic higher education. Practically, it offers guidance for universities, curriculum developers, and lecturers in designing transparent, accountable, and sustainable assessment systems that promote both technological excellence and ethical integrity. Future research should empirically validate the framework across diverse higher education contexts and investigate its effectiveness in improving learning outcomes, AI literacy, academic integrity, and responsible Human–AI collaboration in informatics education.

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