MODELS OF INTEGRATING ARTIFICIAL INTELLIGENCE INTO ASSESSMENT IN HIGHER EDUCATION

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Abstract

The emergence of artificial intelligence (AI) has created both opportunities and challenges, necessitating a fundamental rethinking and redesign of assessment systems in higher education. This study proposes a human-centered, AI-integrated assessment model comprising five key components: (1) digital platforms and infrastructure; (2) assessment data and AI tools; (3) AI-assisted assessment processes with human oversight; (4) stakeholder capabilities and (5) ethical and legal governance. The model's particular contribution lies in the clear integration of pedagogical criteria with the AI system through suggestion-based design, ensuring alignment between automated analysis and educational goals while maintaining the central role of faculty in interpretation and decision-making. The proposed model provides a theory-based framework to guide higher education institutions in designing transparent, adaptive, and ethically accountable assessment systems. It contributes to the research literature by connecting technological innovation with pedagogical integrity and institutional viability, thereby supporting the sustainable and meaningful integration of artificial intelligence (AI) into higher education assessment.

Keywords: *Assessment models; artificial intelligence; higher education; AI-integrated assessment; human-in-the-loop; digital transformation.*

1. Introduction

Under the impact of the Industrial Revolution 4.0, higher education is undergoing a profound transformation, in which artificial intelligence (AI) has emerged as an important technology capable of reshaping every aspect of the teaching and learning process (Quy et al., 2023; Le & Tran, 2024). In this context, assessment, which is central to measuring learning outcomes and ensuring training quality, is facing an urgent need for innovation. Traditional assessment methods, which rely heavily on human resources and are often subjective, reveal limitations in consistency, scalability and providing immediate feedback (Mkhitaryan et al., 2025).

Today, the emergence of automated essay grading systems, such as Project Essay Grade (PEG), Intelligent Essay Assessor, and more recently, large language models (e.g., ChatGPT, DeepAI), has opened up new possibilities for large-scale assessment, especially in important exams such as IELTS (Fathali & Mohajeri, 2025). These tools promise objectivity with automation, processing speed, the ability to provide instant feedback, and personalization (Dinh & Tran, 2021). However, the integration of AI into assessment in higher education is not simply a technical change, but a comprehensive transformation of pedagogical models, lecturers' competencies, and other issues (Quy et al., 2023; Anaso & Anaso, 2025).

The paper proposes a model for integrating AI into assessment in higher education. This model not only considers the technical aspects of AI implementation, but also integrates other relevant factors towards a comprehensive, effective and sustainable assessment system in the digital age.

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2. Research Methods

The study was conducted based on a systematic literature review and content analysis. The selected sources were scientific articles and research reports published in peer-reviewed journals, focusing on the topics: integrating AI in educational assessment, digital transformation of higher education. The main references used were provided, covering a wide range of national contexts (Vietnam, Kazakhstan, Iran, Nepal, Nigeria) and sectors, ensuring diversity and interdisciplinary perspectives.

The analysis process included: (1) Synthesizing key findings on the potential and effectiveness of AI in assessment; (2) Comparing and contrasting to draw commonalities and differences between contexts; (3) Analyzing the challenges mentioned at multiple levels; (4) Synthesizing recommendations and lessons learned; (5) Building and proposing a framework integration model. This method allows for providing a comprehensive, scientifically based, and oriented picture of the application of AI in assessment in higher education. The synthesis ò the reviewed studies served as the methodological foundation for identifying the core dimensions of the proposed AI - integrated assessment model.

3. Literature Review and Synthesis

3.1. Basic Concepts

AI in education is understood as the application of computer systems capable of performing tasks requiring human intelligence such as learning, reasoning, problem solving, perception and understanding natural language into educational processes. In the context of assessment, AI is often demonstrated through automated assessment systems (Automated Assessment) or automated essay scoring (Automated Essay Scoring), using techniques from natural language processing, machine learning and deep learning to analyze and score learners' learning products (Dikli, 2006).

Assessment in higher education is understood as a systematic process of collecting, analyzing and interpreting information in a scientific manner, with the main purpose of determining the level of achievement of the proposed learning objectives as well as the level of meeting the output standards of students. On that basis, this process provides important feedback data to make informed decisions on teaching methods, adjust learning activities, and officially recognize students' abilities. In practice, assessment can be implemented through a variety of forms and types (such as summative assessment, process assessment, practice assessment, criteria-based assessment...), selected and designed to suit the specific purpose of the assessor and the academic context.

3.2. Overview of Artificial Intelligence Integration in Assessment in Higher Education

The integration of AI in assessment in higher education has evolved through several stages, from surface feature-based systems (such as PEG) to semantic models (such as Intelligent Essay Assessor) and now to large language models capable of understanding and generating complex text (Mizumoto & Eguchi, 2023). Main applications include:

- Automatic marking and grading: The core application of AI in assessment is the ability to automatically mark different types of tasks. The system works by mapping the content of the task to the criteria and achievement levels quantified in a predefined rubric. The empirical study by Fathali and Mohajeri (2025) provided convincing evidence for the effectiveness of this application when it showed that the DeepAI tool can mark IELTS Writing Task 2 with the same reliability as certified human examiners, while maintaining high consistency over time. This ability not only frees teachers from a huge workload but also ensures fairness and stability in the assessment standards (Nhung et al., 2024).

- Provide formative feedback: Going beyond grading, AI can also act as an intelligent teaching assistant by providing detailed and timely feedback. By deeply analyzing student work, AI systems can pinpoint specific strengths and gaps in knowledge and skills. Along with problem identification, the technology can suggest actionable suggestions for improvement such as relevant reference materials, supplementary practice exercises, or illustrative examples. This type of immediate and personalized feedback makes assessment an integral part of the learning process, allowing students to continuously adjust and improve.

- Plagiarism and cheating detection: Another important application of AI is to enhance academic integrity through the detection of plagiarism and other forms of cheating (Vu & Luu, 2024). Tools are capable of comparing student submissions against a huge database of academic publications, online materials, and other students' work to detect unusual duplication. Furthermore, as large language models develop, AI can also be trained to recognize AI-generated writing styles, an emerging cheating challenge. Integrating plagiarism detection systems into assessment platforms is an essential step to maintain the fairness and value of degrees (Mkhitaryan et al., 2025).

- Learning data analysis: AI demonstrates superior strength in synthesizing and analyzing large amounts of multidimensional learning data from multiple sources such as scores, participation frequency, learning time on the system and interaction results. From patterns in this data, AI can build predictive models to early identify students at risk of dropping out or learning decline. At the same time, based on individual learning profiles, the system can recommend personalized learning paths and resources. These analyses provide teachers and advisors with valuable information to make timely and effective pedagogical intervention decisions, moving from a reactive model to a proactive support model (Lama et al., 2025).

- Optimizing the question bank: AI-integrated assessment contribute to the construction and improvement of the assessment tool itself - the question bank. Through analyzing the feedback and actual results of learners, technology can evaluate important parameters of each question such as difficulty and discrimination in the questions. The system can automatically detect ineffective questions (such as too easy, too difficult, not distinguishing ability, ...), have confusing expressions or have revealed answers. Based on these analyses, AI can suggest editing, removing or automatically creating new equivalent questions; thereby helping to build and maintain a high-quality question bank, with security and stable measurement value.

3.3. Some Assessment Models in Higher Education

Some common assessment models used in higher education include:

- Traditional assessment model: This model in higher education mainly relies on the central role of the teacher through forms such as writing, oral questions or large assignments. The outstanding advantage of this approach lies in its flexibility and pedagogical sensitivity, allowing teachers to assess complex, unstructured factors such as creativity, critical thinking, and personal style in the expression of learners. However, this model has inherent limitations in that the assessment process is often time-consuming and laborious, especially with large class sizes. More importantly, it is susceptible to subjectivity, potential bias, and examiner fatigue, leading to a lack of consistency in assessment standards, even with the same teacher at different times

- Criteria-based assessment model: To overcome the limitations of subjectivity and inconsistency, the criteria-based assessment model has been developed through the use of detailed rubrics, which clearly list the assessment criteria and the performance levels (from poor to excellent) corresponding to each criterion. This approach significantly improves transparency and fairness because both teachers and students can refer to the same set of objective standards. The clarity and structure of rubrics make in this model an ideal platform for digitalization and AI integration. The criteria quantified in rubrics can be easily converted into algorithms for AI to learn, analyze, and apply automatically and consistently.

- Authentic assessment model: The authentic assessment model aims to measure learners' competencies through the implementation of meaningful tasks, reflecting the challenges and complex contexts of professional and life practices. Instead of focusing on knowledge reproduction, such a model assesses the ability to apply, analyze, synthesize and create to solve problems. Integrating AI into this model opens up new possibilities by supporting the creation and management of complex simulations, simulated situations or providing multidimensional data analysis tools for real projects. Thus, AI becomes a powerful tool to realize and scale up the scale of authentic assessment methods that are resource-intensive.

- Technology-integrated assessment model: In this model represents a shift from manual forms of assessment to the use of digital platforms and tools. At the basic stage, this model includes the application

of Learning Management Systems (LMS), online test creation tools, or electronic learning portfolios to organize, conduct and store assessment results. The development of artificial intelligence is considered an advanced and inevitable step in this trend. AI not only automates existing processes but also adds layers of intelligent analysis, adaptability, and personalized feedback to the technology-integrated assessment ecosystem. From there, this model develops into an intelligent, flexible assessment system that is capable of providing deep insights into the learning process, far beyond the simple scoring function.

3.4. Proposing a Model for Applying Artificial Intelligence in Assessment in Higher Education

Based on the literature review, the study proposes an AI integration model in assessment in higher education that includes the following five interactive elements:

3.4.1. Platform and Infrastructure

This is considered an essential framework for any AI-integrated assessment system. A stable, secure, and high-bandwidth network infrastructure is a prerequisite to ensure continuous access and instant processing of large volumes of data from assessments and responses from cloud-based AI models. Cloud computing not only provides flexible computing power and on-demand scalability, but also facilitates the seamless integration of APIs (application programming interfaces) of advanced AI tools into existing LMSs, transforming LMSs from passive document repositories into intelligent assessment environments. Establishing a centralized assessment platform is the first step to standardizing and streamlining the process. A single portal serves as a single point of connection for all stakeholders (teachers, students, administrators). Interoperability and integration between subsystems (such as assessment platforms, LMSs, student management systems, and external AI tools) must be ensured through open protocols and common data standards. This connection creates a seamless data ecosystem, enabling seamless information flow, thereby supporting comprehensive learning analytics and data-driven decision making.

3.4.2. Data and AI Tools

The quality and relevance of data, along with the selected AI toolkit, are the "raw material" and "engine" of an intelligent assessment system. In terms of data, building a structured and quality assessment data warehouse is the foundation for both training/tuning AI models and establishing reference standards. The more diverse and rich the sample data, the more the AI model can learn variations in wording and task completion, thereby improving the fairness and effectiveness of automated assessment.

In terms of tools, there is no universal AI model for all types of assessment. Therefore, it is necessary to develop or select a diverse set of AI tools, specialized for each task. In particular, it is necessary to pay attention to building an effective communication platform with large models through Prompt Engineering techniques. Designing precise, clear prompts based on the structure of the assessment rubric will guide the AI to analyze and score in accordance with human standards, turning the rubric from instructional text into programmable operating parameters for the automated system.

3.4.3. Evaluation Process

Considered the heart of the model, it operates in a cycle:

- Phase 1 (preparation): Teachers design detailed assessments and rubrics. Rubrics are digitized and converted into input parameters (prompt) for the AI engine.

- Phase 2 (information collection): Students take the assessment on a digital platform. Work is collected automatically.

- Phase 3 (analysis and feedback): The AI engine analyzes the work based on the programmed rubric. The information provided includes preliminary scores, detailed automatic feedback on strengths and weaknesses, and warnings about potential problems (if any).

- Phase 4 (interpretation and decision): Teachers act as intelligent supervisors and perform tasks such as reviewing and adjusting scores, especially in sections that require assessment of creativity, context, or ethics; adding pedagogical feedback and encouraging learners; making final decisions on grades and supporting students.

- Phase 5 (improvement): Data from the assessment process is analyzed to refine the rubric, improve the AI prompt, and improve the quality of future assessments.

3.4.4. Human Resources

A successful transition to an AI-integrated assessment model is deeply dependent on the human resources involved. From the perspective of teachers who directly influence assessment outcomes, teachers are required to not only familiarize themselves with the tools but also develop a set of competencies that combine pedagogical and technical factors. This includes technological knowledge to understand the basic principles and functions of the tools; pedagogical knowledge to design effective assessment activities and most importantly, knowledge to combine assessment content - pedagogy - technology; thereby allowing teachers to choose AI tools that are appropriate to specific content goals and pedagogical strategies. This set of competencies empowers teachers to become intelligent supervisors in the assessment process by knowing how to interpret, verify and evaluate AI outputs; and can add contextual and creative feedback, which machines cannot achieve.

For students, digital competencies also need to be cultivated, including understanding the role of AI in assessment, skills to receive and use automated feedback constructively to improve learning, and full awareness of academic ethics issues in the digital environment. In addition, maintaining a dedicated technical support team - including AI experts, system administrators, and data analysts - is essential to operate, maintain, optimize the system, and resolve complex technical problems.

3.4.5. Ethical and Legal Framework

To ensure legitimacy, fairness, and social acceptance, the implementation of AI in assessment must be guided by a solid ethical and legal framework. The first fundamental principle is transparency, requiring higher education institutions to be open and clear with learners about the use of AI, its purpose, how it works, and especially the limitations of this technology. Next, the principle of fairness must be ensured through testing and minimizing potential algorithmic biases in training data and AI models to prevent systemic disadvantage for any group of students based on personal characteristics. Third, learners' data privacy must be absolutely respected through strong security measures and compliance with current legal regulations on personal information security, especially when assignments and personal feedback become input data for AI systems. Fourth, accountability must be clearly defined, affirming that the final assessment decision and responsibility for learning outcomes always rest with humans, and that a transparent and effective grievance mechanism must be established to handle disputes. Finally, it is necessary to promulgate a clear academic policy on the use of AI, which addresses the line between legitimate uses of AI to support learning and fraudulent behavior; thereby guiding behavior and protecting academic integrity in the digital age.

3.5. Ethical and Legal Considerations

According to studies, the implementation of AI in assessment in general, and higher education in particular, raises many ethical and legal issues that need to be addressed from the outset. These issues include:

- Algorithmic bias: One of the core ethical challenges is the existence of algorithmic bias. AI models are trained on large data sets. But if these data contain cultural, social, gender, or linguistic biases, they are inadvertently encoded and amplified in the algorithm. This leads to unfair assessments, inadvertently reinforcing and reproducing existing inequalities in society, undermining the fairness that is the foundational principle of education.

- Validity and reliability: Integrating AI into assessment requires close monitoring of validity and reliability. First, validity asks whether the AI tool is truly measuring the target competency or knowledge, or whether it is simply assessing superficial, easily quantifiable factors (such as sentence length, vocabulary complexity). Second, reliability relates to the consistency of assessment results. A system needs to be tested to ensure that the same task, when assessed under similar conditions, receives consistent scores. The absence of regular and rigorous assessment of these two criteria can

lead to erroneous conclusions about student ability, which in turn negatively affects their academic decisions and future.

- The "Black Box" phenomenon: The complexity of many AI models often leads to the "black box" phenomenon, where the algorithm's internal decision-making process is difficult, if not impossible, to explain clearly. When an essay receives a particular score, it is difficult to determine exactly what factors led to that result and how they were weighted. This lack of transparency makes it difficult for teachers to defend or adjust the results and, more importantly, undermines students' trust in the fairness and meaning of the assessment. Students have the right to understand the reasons behind their scores so they can improve.

- Negative impact on pedagogical practice: When students perceive that AI systems favor certain structures, vocabulary, or argumentative formulas, they tend to adapt their work to meet the system's requirements instead of focusing on developing creative, original, and critical thinking. This can lead to a formulaic education where diversity in writing style, risk-taking in ideas, and depth of thought are replaced by safe and uniform work.

- Intellectual property and data privacy issues: Integrating AI into assessment raises complex questions about intellectual property and data privacy. Student work and exams – which are their intellectual products – are often used as data to train, refine and improve AI models. However, policies on who owns this data, how it is used, where it is stored and whether students are informed, consented to or benefit from such use are often unclear. The lack of a solid legal and ethical framework around this issue not only violates learners' privacy but can also lead to future intellectual property conflicts.

3.6. Opportunities and Challenges

Today, integrating AI in assessment offers higher education institutions the following opportunities:

- Improving the quality and effectiveness of assessment: Integrating AI into assessment systems creates conditions for a structural transformation of the quality of this activity. AI has the ability to bring high objectivity and consistency through the application of assessment criteria in a mechanical way, unaffected by subjectivity, fatigue or potential bias of the assessor. Moreover, this technology also allows for providing instant and detailed feedback, turning the assessment process from an activity into a learning tool, helping learners recognize strengths and weaknesses and make timely adjustments. The combination of algorithmic objectivity and flexibility in feedback makes assessment more meaningful and fair for all learners.

- Unleashing Teachers' Pedagogical Power: One of the most practical benefits of AI is its ability to automate repetitive and time-consuming administrative tasks in assessment, such as grading tests, assignments, or initial screening of essays against rubrics. This support significantly reduces teachers' workload, freeing up valuable time and intellectual energy. Teachers can then focus on high-quality, deeply interactive pedagogical activities, such as designing complex assessment scenarios, organizing in-depth discussions, providing personalized advice, and developing creative, authentic learning experiences. This does not diminish the role of teachers, but rather elevates their role from graders to facilitators and creators of knowledge.

- Promoting personalized learning at a deep level: AI excels at analyzing large amounts of individual learning data. By analyzing each student's error patterns, progress rate, learning style, and strengths/weaknesses, the technology can accurately identify each individual's unique learning needs. Based on that, the system can automatically recommend appropriate learning resources, supplementary exercises, optimal learning paths, and even adjust the difficulty of the content. This realizes an adaptive education model, where the learning process is flexibly adjusted according to the actual capacity of the learner, instead of imposing a rigid program for all. This is an important step towards a truly learner-centered education.

- Expanding the boundaries of real-world competency assessment: AI opens up the possibility of assessing complex and highly practical competencies that are difficult to measure effectively with traditional methods. Through virtual reality (VR) or augmented reality (AR) simulations, AI can

place learners in complex simulated situations and assess their decision-making, problem-solving, or technical skills. For multimedia learning projects (such as videos, graphic design, programming models), AI can support the analysis of content, structure, and creativity. Thus, this technology does not only stop at testing knowledge but also contributes to assessing performance capacity, meeting the requirements of training high-quality human resources in the new era.

- Creating Big Data for Educational Research and Improvement: AI-assisted assessment will generate a massive and structured Big Data repository on learner behavior, performance, and learning progress. This data, once processed, will become a valuable resource for educational research. Researchers can analyze it to discover learning patterns, identify predictors of success, or detect bottlenecks in training programs. Based on insights from the data, administrators and program designers can make evidence-based decisions to improve training programs, teaching methods, and assessment systems, thereby improving the quality of education systematically and sustainably.

However, along with the opportunities, there are some challenges that need to be addressed as follows:

- Financial challenges and investment resources: Integrating AI into the assessment system requires a huge initial and ongoing financial investment, which is a significant barrier, especially for educational institutions in low- and middle-income countries. The cost does not stop at upgrading IT infrastructure (such as servers, network bandwidth, terminals) but also includes purchasing copyrights or developing specialized AI platforms and tools. Moreover, financial resources must also be allocated to systematic and continuous training and human resource development programs to build capacity for management teams, teachers and support staff. Without a long-term and sustainable investment strategy, AI implementation can easily stop at the pilot stage or fail to achieve optimal efficiency.

- Challenges of digital divide and capacity gap: A structural obstacle is the existence of a digital divide and deep differences in technological capacity between stakeholders. At the national and regional levels, differences in telecommunications infrastructure and access to high-quality internet can create inequalities in implementation. At the individual level, some studies show that the pedagogical and technological capacity of many teachers in AI is very low, with no significant gender differences. At the same time, students from rural, remote or economically disadvantaged areas often lack the necessary personal equipment and digital skills. This disparity not only reduces the effectiveness of implementation but also risks exacerbating inequalities in access to quality education.

- Challenges of changing organizational culture and mindset: The human factor and organizational culture are often the most important but difficult to measure challenges. The transformation process can encounter natural resistance from both teachers and related teams. Teachers may be concerned about technology replacing their professional roles, increasing pressure to learn new skills, or doubting the effectiveness and fairness of AI tools. On the leadership side, there may be a traditional management mindset, fear of change, or lack of strategic vision for digital transformation. Without an effective communication, consultation, and motivation strategy to build consensus and trust, AI-integrated assessment initiatives can stagnate or remain only a formality.

- Challenges in legal and policy frameworks that have not kept up: The rapid development of AI has created a significant gap compared to the speed of building and perfecting the legal system. Policies, regulations and standards related to AI applications in education, especially in the field of assessment, are often slow to be issued or lack consistency. Issues such as standards for recognizing online assessment results using AI, standards for student data security, regulations on accountability in case of incidents or guidelines on ethical issues in using AI have not yet been clarified. The absence of a clear and flexible legal corridor not only causes apprehension for educational institutions that want to be pioneers but can also lead to unpredictable consequences in terms of governance and protection of the rights of stakeholders.

4. Conclusion

The development of AI is opening a new chapter for assessment in higher education, promising

significant improvements in objectivity, efficiency, and personalization. Studies from a variety of contexts have provided early evidence of this potential, from high-reliability scoring of language essays to supporting assessment decisions and boosting student learning outcomes. However, successful AI integration is not straightforward, especially in developing countries, with challenges.

The challenges do not lie in the technology itself but in the people and the operating system. The lack of technological-pedagogical capacity of teachers, the lack of digital infrastructure, the slow innovation of policy frameworks and the issues of ethics and validity are barriers that need to be addressed synchronously. The AI integration model proposed in the article emphasizes a mixed and human-centered approach, where AI is a powerful support tool and not a replacement for the professional role of teachers.

To realize this model, higher education institutions need to do the following: (1) Prioritize staff capacity development; (2) Develop a realistic and sustainable digital infrastructure investment roadmap, taking into account the specific conditions of the school and students; (3) Proactively advise and develop internal regulations and guidelines on the use of AI in assessment, creating a safe and clear corridor for teachers when applying; (4) Establish a mechanism for periodic monitoring and evaluation of the effectiveness, fairness and ethics of AI tools used, ensuring they truly serve the goal of improving the quality of education.

Limitations: This study is primarily based on a systematic literature review and document analysis. Therefore, the proposed model has not yet been empirically validated through experimental or large-scale implementation in real university contexts. Although the reviewed studies cover diverse national contexts, the applicability of the proposed model may vary depending oninstitutional capacity, technological infrastructure, and policy environments, particularly in developing countries.

Future research directions: Future studies should conduct empirical experiments or pilot implementations to evaluate the effectiveness, reliability, and validity of AI- assisted assessment models in real teaching contexts.

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