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Artificial Intelligence in Personalized Learning and Student Assessment: Challenges and Implementation Solutions

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ABSTRACT: This paper analyzes the role of artificial intelligence (AI) in personalizing learning and reforming assessment and evaluation in higher education, with a particular focus on the context of Vietnam. AI offers new opportunities to improve the quality of teaching and learning through technologies such as machine learning, natural language processing, learning analytics and intelligent assistants, enabling the design of tailored learning pathways via adaptive learning systems and personalized learning resources. In assessment, AI supports automatic grading, timely feedback, detection of knowledge gaps and enhances fairness and transparency. However, implementing AI in Vietnamese higher education faces several challenges: uneven technological infrastructure, an underdeveloped legal and regulatory framework, limited digital competencies among faculty and students, and ethical and data-security concerns. The study proposes solutions including upgrading digital skills for faculty and students; investing in technological infrastructure; completing policies and legal frameworks; strengthening data security; and promoting research–industry collaboration. These measures will help Vietnamese higher education harness AI’s potential effectively, moving toward a personalized, equitable and sustainable education system.

KEYWORDS: Artificial Intelligence (AI), digital transformation, personalized learning, assessment, higher education.

1. INTRODUCTION

The Fourth Industrial Revolution has already created profound transformations across many domains, with higher education among the sectors most directly affected. Core technologies driving this revolution—such as artificial intelligence (AI), big data, the Internet of Things (IoT) and cloud computing—not only change production and management processes but also open up novel modalities of teaching and learning (Schwab, 2017). Within this context, AI has emerged as a strategic tool to personalize learning processes, optimize assessment and evaluation, and improve the efficiency of higher-education administration (Zwick-Richter et al., 2019).

In Vietnam, the fundamental and comprehensive reform of education is articulated in Resolution 29-NQ/TW of the Party Central Committee (2013), which emphasizes the need to renovate teaching methods and assessment systems and to accelerate the application of technology in management and pedagogy. Consistent with this orientation, the Education Development Strategy to 2030 (vision to 2045) highlights digital transformation and AI adoption as pivotal measures to enhance education quality and strengthen international integration (Prime Minister, 2024). Against this global backdrop, personalized learning is considered essential to meet the diversity of learners’ needs, abilities and learning styles. AI-based adaptive learning systems can analyze learning data, identify knowledge gaps and recommend content tailored to each individual (Holmes et al., 2019). Correspondingly, assessment practices are shifting toward continuous, data-driven, and objective approaches to ensure fairness and improve learning outcomes (Müller & Müller, 2023). Therefore, researching and applying AI for personalized learning and assessment in higher education aligns not only with international trends but also with Vietnam’s strategic imperative during the digital transformation era.

2. LITERATURE REVIEW

2.1 Theoretical foundations and literature overview

2.1.1 Definitions and AI technologies in education

Artificial Intelligence (AI) is defined as the capability of computer systems to perform tasks that normally require human intelligence, including learning, reasoning, natural language processing and decision-making (Russell & Norvig, 2021). In education, AI is viewed as an ensemble of technologies that enhance teaching and learning by processing learning data, simulating cognitive processes and personalizing learning experiences (Holmes, Bialik & Fadel, 2019).

Key technologies underpinning AI applications in education include:

Machine Learning (ML): ML enables systems to learn from data and progressively improve performance without being explicitly programmed. In education, ML is used to analyze learning data to predict outcomes, detect knowledge gaps and recommend appropriate learning resources (Jordan & Mitchell, 2015; Baker & Siemens, 2014).

Natural Language Processing (NLP): NLP allows computers to understand and generate human language, supporting interactions among teachers, students and learning systems. In educational contexts, NLP is applied to automated essay grading, analysis of student feedback, translation and development of conversational learning agents such as ChatGPT (Young et al., 2018; Kosemci et al., 2023).

Learning Analytics: This field combines AI and data analysis to collect, measure and interpret learners' behaviors to improve teaching-learning environments. Learning analytics help instructors monitor progress, predict students at risk and design timely interventions (Siemens & Long, 2011; Ifenthaler & Yau, 2020).

Intelligent Tutoring Systems and Conversational Agents: These systems, built on ML and NLP, interact with learners in natural language, provide instant feedback, guide study and answer queries 24/7. They reduce routine teacher workload and improve access to learning resources and personalized support (Følstad & Brandtzaeg, 2017; Yu-Sheng & Rui-Yi, 2022).

In sum, AI in education is not merely the application of isolated algorithms but the integration of diverse technologies serving central objectives: optimizing instructional activities, personalizing learning and enhancing the quality of assessment.

2.1.2 Personalized learning

Personalized learning refers to the design, organization and adjustment of learning activities based on each learner's needs, abilities, interests and goals, rather than applying an identical pathway to the entire class (Walkington, 2013). Personalized learning involves adjusting learning pace, building content driven by individual data and empowering students in decision-making related to their learning (Pane et al., 2015).

In higher education, personalized learning is increasingly considered a necessary approach to enhance learning efficiency-especially when combined with advanced technologies such as AI. Typical features include customized content aligned with students' goals and proficiency, adaptive teaching methods and support tools tailored to learning styles, and emphasis on learner autonomy and engagement (Durlak & Lesgold, 2012; Holmes et al., 2019).

Representative models of personalized learning include:

Adaptive learning systems: AI algorithms analyze students' learning data in real time and adjust content and sequencing to match individual abilities (Kerr, 2016).

Competency-based learning: Focus on students achieving defined competencies rather than merely completing credit hours; AI supports measuring attainment levels (Pane et al., 2015).

Data-driven learning: Exploiting big data and learning analytics to predict learning trajectories, identify at-risk students and suggest interventions (Siemens & Long, 2011).

Self-regulated learning: Encouraging learners to set goals, manage pace and self-assess, with AI providing feedback and strategy suggestions (Ifenthaler & Yau, 2020).

Therefore, personalized learning is an inevitable trend in higher education during the digital transformation. Integrating AI with personalized models helps optimize learning experiences, improves graduate quality, promotes equity and creates favorable conditions for comprehensive student development.

2.1.3 Assessment in the digital context

In traditional education systems, assessment is often implemented as end-of-term examinations to measure learners' knowledge acquisition. However, this approach lacks flexibility, does not fully reflect the learning process, and poorly supports timely remediation (Black & Wiliam, 2009).

The rapid development of digital technologies-particularly AI and learning analytics-has driven a shift from summative assessment toward formative, process-oriented assessment. Digital-context assessment is conducted continuously throughout learning, enabling instructors to monitor progress, detect gaps and adjust instruction in a timely manner. AI and Learning Management Systems (LMS) can collect detailed learning data (e.g., time on tasks, interaction levels, quiz outcomes) to provide prompt, personalized feedback (Ifenthaler & Yau, 2020). Assessment thus ceases to be merely a scoring tool and becomes a means to support continuous improvement.

Assessment for learning is progressively replacing narrowly defined outcome measurement. In digital contexts, assessment is integrated into daily activities using online tools, interactive simulations or formative tasks that sustain motivation and encourage active engagement. AI-based quizzes, automated grading systems and learning dashboards do not simply measure achievement but also propose learning strategies for students (Müller & Müller, 2023).

Finally, digital assessment emphasizes fairness and transparency. AI can reduce subjective bias in grading and ensure consistency across assignments and student groups. This is particularly important in large-class settings and diverse learner populations (Müller & Müller, 2023). Overall, digital transformation has reframed assessment-shifting from end-term measurement to continuous, personalized and equitable support for learning, thus underpinning comprehensive education reform in the AI era.

2.1.4 International and domestic research overview: AI for personalized learning and student assessment

International research overview

Over the past decade, AI has become a central research area in global higher-education studies. Numerous works demonstrate AI's potential to personalize learning and improve assessment, thereby enhancing teaching and learning effectiveness.

Research on personalized learning shows that adaptive learning systems can tailor content, pace and methods to individual needs. In the United States, Carnegie Mellon developed Intelligent Tutoring Systems (ITS) that analyze student behavior and provide instant feedback, improving course completion rates by 15–20% versus traditional methods (VanLehn, 2011). Stanford University's work on algorithmic course recommendations and individualized learning materials has also contributed to retention enhancement (Nguyen et al., 2021). In China, collaborations between universities and AI firms have produced adaptive learning platforms that reduced average learning time by 40% while maintaining or improving final outcomes (Zwick-Richter et al., 2019).

Research on assessment indicates AI's efficacy in automating and enhancing evaluation quality. AI can design assessments, deliver personalized feedback and help instructors monitor student progress in real time. Tools like Gradescope have been widely used in the US and Europe to auto-grade both multiple-choice and written responses, shortening grading time by up to 70% and improving rubric consistency (Peché et al., 2015). Learning-analytics dashboards are increasingly deployed in universities to interpret process data and inform pedagogical adjustments (Ifenthaler & Yau, 2020).

Overall evidence suggests AI is driving fundamental shifts in personalized learning and student assessment while highlighting the need for legal, ethical and competency frameworks to ensure responsible, equitable use (Luckin et al., 2016).

Domestic research overview (Vietnam)

Recently, Vietnam's research ecosystem on AI applications in higher education has grown markedly, focusing on two main axes: (1) personalized learning through adaptive learning systems, AI tutors and learning analytics; and (2) assessment innovation using AI-supported grading tools and dashboards for monitoring progress.

Studies published in Vietnamese journals underscore the roles of ML, NLP and learning analytics in recommending content, adjusting pace and supporting student decision-making, while also noting barriers such as limited digital skills among faculty and incomplete data infrastructure (Nguyen Vo Anh & Nguyen Chi Ha, 2025). Policy analyses emphasize the need for digital competency frameworks and ethical standards for handling learner data to scale personalized learning (Vietnam Journal of Educational Sciences, 2022).

Empirical studies have explored tools such as ChatGPT in teaching and assessment, reporting benefits like accelerated feedback and enhanced personalization but also warning of dependency risks and the absence of transparent assessment standards—calling for clear criteria to ensure equity and academic integrity (Nguyen, 2025). Surveys indicate growing student acceptance and use of AI tools—particularly in urban areas—where perceived usefulness and ease of use strongly influence adoption and academic outcomes (Kinh Te & Du Bao, 2025).

In sum, domestic studies reveal increasing adoption and promising results but also highlight the need for system-level supports—data standards, ethical frameworks and capacity building—to implement AI-driven personalization and assessment at scale.

2.2 The role of AI in personalized learning and assessment

2.2.1 AI for personalized learning

One of AI's most consequential applications in higher education is the capacity to personalize learning. Rather than delivering identical content and pathways to all students, AI enables the design of learning experiences attuned to individual abilities, interests and pace, thereby improving effectiveness and motivation (Holmes, Bialik & Fadel, 2019).

Key applications include:

Adaptive learning systems: AI analyzes students' learning data (test scores, system interactions, study time) and adjusts content and sequencing in near real time (Kerr, 2016). Platforms such as Knewton and Squirrel AI have demonstrated reductions in study time of 30-40% while preserving or improving learning outcomes (Zwick-Richter et al., 2019).

Personalized learning materials: AI is increasingly used to generate diverse resources tailored to course specifics and student needs. Tools such as ChatGPT assist instructors in designing discussion prompts and scenarios; AI lesson-planning tools can auto-generate detailed lesson plans aligned with learning objectives; AI-driven content converters produce infographics, videos or interactive resources (Kosemci et al., 2023).

Intelligent learning assistants: Chatbots and AI tutors provide 24/7 support across online and face-to-face learning environments. They answer queries, explain concepts, recommend supplementary materials and send reminders, fostering engagement and continuity (Følstad & Brandtzaeg, 2017; Yu-Sheng & Rui-Yi, 2022).

Collectively, these AI-enabled applications realize a learner-centered approach in higher education, aligning with the global trend toward digital transformation.

2.2.2 AI for assessment and evaluation

Assessment is a critical component of education because it not only reflects learning outcomes but also shapes teaching and learning directions. In the digital transition, AI is increasingly used to modernize and optimize evaluation processes toward automation, transparency and support for continuous learning (Holmes, Bialik & Fadel, 2019).

Prominent AI uses include:

Automated grading and feedback: Tools such as Gradescope are widely adopted to grade objective and subjective items, using handwriting recognition and consistent rubric application to reduce grading time by up to 70% (Peché et al., 2015). AI quiz platforms and Google Forms with AI extensions can auto-generate exam items from course materials and analyze results to suggest question adjustments (Müller & Müller, 2023). Turnitin's Draft Coach and similar tools detect issues in writing and provide detailed feedback that help students refine academic skills (Sutherland-Smith, 2019).

Learning dashboards: Dashboards aggregate process data—not only scores but also participation metrics and task completion rates—allowing early detection of at-risk students and recommending timely interventions to instructors (Ifenthaler & Yau, 2020). Consequently, assessment becomes a tool for continuous, personalized learning support.

Reducing bias and increasing transparency: Consistent algorithmic grading and audit trails increase objectivity and provide evidence for each assessment result, enhancing fairness and trustworthiness (Zwick-Richter et al., 2019).

AI is thus transforming assessment from a terminal measurement instrument into a continuous, objective and transparent support system. Nevertheless, realizing this potential requires investments in infrastructure, legal frameworks and digital competencies to ensure quality and ethical use.

2.3 Challenges in implementation

2.3.1 Technology and infrastructure

A major barrier is uneven ICT infrastructure. Many higher-education institutions lack sufficiently powerful networks and servers to process large volumes of learning data in real time. Learning data are often fragmented, unstandardized and dispersed across multiple platforms, complicating development of adaptive systems and analytics. The absence of centralized, standardized datasets limits analytical capacity and hinders the build-out of robust predictive models.

2.3.2 Faculty and student capacity

Limited digital skills are a significant challenge. Many instructors have yet to master the effective exploitation of AI tools for designing materials, constructing assessment items or analyzing learning data. Students—despite being digital natives—often use AI for short-term purposes (e.g., getting answers) rather than leveraging it as a tool for sustained learning. Both teachers and students harbor concerns about accuracy and academic validity of AI outputs, especially regarding biased information and opaque analytic outcomes.

2.3.3 Policy and governance

Another challenge is the lack of appropriate legal and governance frameworks. Vietnam has not yet promulgated explicit regulations recognizing learning outcomes assisted by AI, nor established unified guidance on learning-data standards, privacy procedures or legal responsibilities for AI use in assessment. This regulatory gap generates uncertainty for institutions and limits scaling of AI applications system-wide.

2.3.4 Ethics and security

AI in education raises several academic-integrity issues. Tools can be misused for plagiarism or automated content generation that undermines fairness. Moreover, student learning data frequently contain sensitive personal information; inadequate protections risk misuse or data breaches. Without clear ethical standards and governance on data handling, serious consequences may undermine trust among faculty and students. In summary, implementing AI in higher education is not merely a technical task but one closely tied to human capacity, policy governance and academic ethics. Identifying these challenges is a prerequisite for designing effective, sustainable solutions in Vietnam.

2.4 Implementation solutions

2.4.1 Enhance digital competencies of faculty and students

Faculty and students are central to AI adoption; thus, improving their digital competencies is vital. Regular professional development programs such as “AI for Educators” should equip instructors with skills to use AI tools for instructional design, build item banks for assessment and analyze learning-data to personalize instruction. Establishing practitioner communities will facilitate experience sharing and dissemination of exemplary practices. Implementation conditions require institutional and Ministry-level support for recurring training plans, budget allocation, AI specialist teams, and recognition mechanisms (certificates) for digital competencies as part of continuous professional development.

2.4.2 Standardize and invest in technological infrastructure

A robust, interoperable ICT infrastructure is foundational. Institutions should prioritize investment in AI-integrated LMS (e.g., Moodle, Canvas) that enable personalized content, learning dashboards and timely feedback. Upgrading data servers and high-speed Internet connectivity is essential to store, process and analyze large datasets. Implementation requires medium- and long-term investment plans, technical standards for LMS and centralized data repositories to ensure interoperability. Financial resources can be mobilized through state budgets, tuition, and public-private partnerships with EdTech firms. Technical teams must be trained to maintain and upgrade systems reliably.

2.4.3 Improve policies and legal frameworks

To ensure sustainable AI adoption, it is necessary to issue formal regulations governing AI use in teaching and assessment, specifying scope, rights and obligations of stakeholders, and criteria for recognizing AI-assisted learning outcomes. Developing an AI ethics framework for education is crucial to guide proper usage and safeguard academic integrity, transparency and fairness. The Ministry of Education and Training should lead drafting legal instruments aligned with international standards (e.g., UNESCO, OECD) while adapting them to Vietnam’s context. Institutions and practitioners should be consulted to ensure practicality. Cross-sector advisory councils (education, technology, law, ethics) are recommended to ensure comprehensive and updatable governance.

2.4.4 Strengthen data security and governance

Student learning data often include personal and sensitive information; therefore, stringent data-protection mechanisms are necessary. Adopting international standards such as GDPR and robust encryption techniques will ensure information security. Regular risk monitoring and audit mechanisms should detect leaks or system abuses early. Clear procedures for data access, anonymization, retention and accountability are essential.

2.4.5 Promote research and collaboration

AI applications in higher education are most effective when grounded in empirical research. Universities should foster partnerships with EdTech companies to develop and pilot AI models tailored to educational contexts. Pilot studies are required to evaluate specific impacts of AI on personalized learning and assessment in Vietnam. Results from such trials will inform scalable solutions and policy refinements. Implementation conditions include public funding, research grants, establishment of institutional R&D centers on AI in education and encouragement of international collaborations for knowledge and technology transfer. Transparent data-sharing protocols for research will promote academic scrutiny and practical relevance of AI models.

These solutions are interdependent and should be implemented in a coordinated manner: capacity building-technology investment-policy development-data security-research and collaboration. Only through such a comprehensive approach can AI be applied effectively and sustainably in Vietnam’s higher education sector.

3. RESEARCH METHODS

This study employs a qualitative analysis method based on secondary data to clarify the roles, challenges, and implementation solutions of Artificial Intelligence (AI) in personalized learning and student assessment at Vietnamese higher education institutions. The research design adopts a descriptive and analytical review approach, integrating systematic literature review with policy analysis.

Secondary data were collected from the following sources: domestic and international studies on AI applications in higher education from 2015–2025; Vietnam's education policy and strategy reports, including Resolution 29-NQ/TW, the Education Development Strategy through 2030, and documents from the Ministry of Education and Training; and experimental studies and surveys published in educational science journals that provide data on the effectiveness of adaptive learning systems, automated assessment tools, and the level of AI adoption by lecturers and students. Data analysis methods include content analysis to identify key themes related to opportunities, challenges, and implementation solutions for AI. In addition, a comparative synthesis method was used to contrast international evidence with the Vietnamese context, thereby deriving appropriate recommendations. The analytical framework is structured around four groups of factors: (a) technology and infrastructure, (b) digital competence, (c) policy and legal framework, and (d) ethics and data security.

However, this study has several limitations. Reliance on secondary data makes it difficult to comprehensively reflect implementation practices across all educational institutions. The findings are generalized and need to be validated through future empirical studies to enhance broader applicability.

4. CONCLUSION AND RECOMMENDATIONS

4.1 Conclusions

Based on theoretical analysis and literature review, AI is opening important opportunities for higher education-particularly for personalized learning and assessment. International evidence shows AI can adapt learning pathways to individual characteristics, provide timely feedback, automate grading processes and detect knowledge gaps early. These applications improve learning outcomes, promote fairness and increase transparency.

However, the Vietnamese context still presents several obstacles to AI deployment at scale: uneven ICT infrastructure, lack of legal and data standards, limited digital competencies among faculty and students, and academic-ethics and data-security concerns. Therefore, alongside leveraging AI's potential, a comprehensive and coordinated strategy is required to maximize benefits and mitigate risks, ensuring AI adoption in higher education is effective, sustainable and human-centred.

4.2 Recommendations

4.2.1 For the Ministry of Education and Training (MOET)

MOET should promptly issue a comprehensive policy framework for AI application in education that defines principles, scope and data standards. It should support investment programs for technological infrastructure-especially servers, high-speed Internet and AI-enabled LMS-and provide guidance for institutional implementation.

4.2.2 For universities

Universities should invest in AI-integrated LMS (e.g., Moodle, Canvas) to enable personalized content delivery and institution-wide assessment dashboards. They should regularly organize capacity-building workshops for faculty to promote effective AI use in course design, assessment and learning support.

4.2.3 For faculty and students

AI should be regarded as a supportive tool for teaching and learning, not a replacement for academic competence. Faculty should proactively use AI to design materials, analyze learning data and deliver personalized feedback while maintaining the role of guidance and oversight. Students must develop responsible AI-use skills, leveraging tools to enhance self-learning, creativity and critical thinking rather than relying solely on AI outputs.

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