



OPPORTUNITIES FOR PERSONALIZING THE EDUCATIONAL PROCESS THROUGH ARTIFICIAL INTELLIGENCE

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Abstract. *This article examines the pedagogical, technological, and organizational opportunities for personalizing the educational process through artificial intelligence (AI). Personalized learning involves adapting educational content to the learner's level of knowledge, pace of learning, interests, needs, language competence, and preferred learning style. AI can facilitate this process through diagnostic assessment, adaptive learning platforms, intelligent tutoring systems, automated assessment, natural language processing, and generative models. The article also considers the pedagogical conditions required for effective AI integration, including teacher supervision, academic integrity, data protection, and equal access to digital infrastructure. Particular attention is paid to identifying learning gaps, designing individual learning pathways, providing differentiated tasks, delivering timely feedback, and supporting inclusive and independent learning. The study emphasizes that AI should not replace the teacher but should expand the teacher's capacity to understand individual learner needs, plan instruction more precisely, and support student development. For Uzbekistan, expanding Uzbek-language educational content, improving digital infrastructure, and developing teachers' AI competencies are identified as important conditions for effective implementation.*

Keywords: *artificial intelligence, personalized learning, adaptive learning, intelligent tutoring system, digital pedagogy, generative AI, learning analytics, teacher competence, academic integrity.*

In contemporary education, the approach of providing all learners with the same content, identical tasks, and the same amount of time is increasingly being

reconsidered. Learners in the same classroom differ in their level of knowledge, interests, learning pace, psychological characteristics, and independent learning skills. Some learners grasp a new topic quickly, whereas others need additional examples, visual materials, or repetition. In a traditional classroom, it is difficult for a teacher to simultaneously adapt instruction to the individual needs of 25–35 learners. From this perspective, artificial intelligence is becoming an important tool for personalizing education. AI can analyze learner activity, identify errors, determine appropriate levels of subsequent tasks, and in some cases provide individualized explanations. However, introducing AI into education is not merely a technical issue; it is closely connected with pedagogical objectives, teacher responsibility, learner rights, and information security. UNESCO reports that only about 40 percent of primary schools and 50 percent of lower-secondary educational institutions worldwide are connected to the Internet [1]. This indicates that digital inequality remains a relevant issue. Therefore, while AI can support personalized learning, insufficient infrastructure and unequal access may also widen educational disparities. The effective personalization of learning therefore requires a continuous cycle of diagnosis, adaptation, feedback, and reassessment. AI can support this cycle by processing learner data quickly, but the interpretation of that information remains a pedagogical task. A learner's performance may be affected by motivation, fatigue, access to technology, language background, or other contextual factors that cannot always be adequately represented by numerical indicators. Personalization should be understood not as the complete separation of learners into individual educational programs, but as the flexible organization of common learning objectives according to differences in learners' starting levels, learning pace, interests, and support needs. This distinction is particularly important in primary education, where learners may demonstrate substantial differences in reading comprehension, language development, attention, and independent work skills.

Personalized learning is often understood as providing a separate lesson for every learner. In practice, however, personalization means adapting the content,

pace, complexity, explanation method, task type, and assessment format of the learning process to individual needs.

Personalized learning includes the following components: identifying the learner's, initial level of knowledge, detecting learning gaps, setting individual learning goals adjusting the pace of learning, providing tasks at different levels of difficulty, giving timely and understandable feedback, regularly analyzing learning outcomes, organizing teacher intervention when necessary.

Benjamin Bloom's "Two Sigma Problem," proposed in 1984, is an important study demonstrating the difference between individual tutoring and conventional group instruction. Bloom showed that learners receiving one-to-one tutoring achieved substantially higher results than those receiving conventional classroom instruction [2]. However, assigning a human tutor to every learner requires considerable financial and organizational resources. AI-based adaptive systems can address some aspects of this challenge. They cannot fully replace a human tutor, but they can rapidly analyze learner responses, recommend additional exercises, and provide continuous answers to routine questions. VanLehn's research review showed that intelligent tutoring systems can, under certain conditions, be more effective than conventional computer-based instruction and, for some outcomes, approach the effectiveness of human tutoring [3].

At the same time, predictive information should be interpreted cautiously. Automated systems may reproduce biases present in their training data or may misinterpret incomplete behavioral information. For this reason, AI-generated indicators should be treated as signals for pedagogical attention rather than as definitive judgments about a learner. An important advantage of AI-supported learning analytics is the possibility of identifying patterns that may remain unnoticed during routine classroom observation. For example, a sequence of similar mistakes can indicate that a learner has misunderstood a particular concept rather than simply made an accidental error. Early identification allows the teacher to provide targeted explanation, additional practice, or a different representation of the same material.

AI can analyze attendance, task completion time, errors, test results, and activity on educational platforms to identify learners who may be experiencing difficulties. Relevant indicators include: failure to complete tasks regularly, repeated errors in the same topic, a sharp decrease in time spent accessing the learning platform, a continuous decline in test results, persistent avoidance of complex tasks, Such prediction should not be used to label a learner as “low-ability”; rather, it should serve as a basis for providing timely support. In primary education, this model can be adapted to reading, writing, mathematics, and language learning. For example, in reading instruction, an AI-supported system could distinguish between difficulties in decoding words, understanding vocabulary, identifying the main idea, and making simple inferences. The teacher could then select activities that address the specific difficulty rather than repeating the entire lesson for all learners. The five-stage model can be viewed as a formative assessment cycle. Its main purpose is not to automate teaching, but to make the teacher’s decisions more evidence-informed. Diagnosis establishes the learner’s starting point; profiling organizes relevant information; differentiated pathways provide an appropriate level of challenge; teacher supervision ensures pedagogical and ethical control; and reassessment demonstrates whether the selected intervention has produced meaningful progress.

An AI-supported personalized lesson can be organized in five stages. First stage — Diagnosis. At the beginning of the lesson, an 8–12-item diagnostic test can be administered. It should assess not only factual knowledge but also basic skills related to the topic. Second stage — Developing an individual profile. The system creates a learner profile based on knowledge level, strengths and weaknesses, learning pace, task-related errors, and preferred learning format. This profile should remain a continuously updated working model rather than a permanent label. Third stage — Selecting an individual pathway. Although learners study the same topic, they can receive different levels of tasks: basic tasks involving rules and simple examples, intermediate standard problems, and advanced problem-based or creative tasks. Fourth stage — Teacher supervision. The teacher should not accept AI

recommendations as final judgments. Recommendations should be evaluated against pedagogical objectives, the learner's situation, and actual classroom conditions. Fifth stage — Reassessment. At the end of the lesson, a short test or practical task can be administered and compared with the initial diagnostic result. If the learner has not achieved the objective, additional explanation and practice should be provided. For example, in an algebra lesson, an AI system may identify learners who know the formula but make procedural errors, learners who do not understand how to transform an equation, and advanced learners who are ready for more complex problems. Instead of assigning the same 20 exercises to everyone, differentiated pathways can be created. This saves time and allows learners to work on tasks corresponding to their needs. Another potential benefit is the creation of more flexible learning materials. The same concept can be presented through a short explanation, an example, a visual representation, a guided exercise, or an additional practice task. Such variation can help learners approach the same learning objective through different routes while maintaining common curricular expectations. These advantages are especially relevant when AI is integrated as part of a broader pedagogical system. The greatest value arises when automated analysis is combined with teacher observation, formative assessment, collaborative activities, and direct communication with learners. Technology can process information at scale, while the teacher provides context, emotional support, motivation, and professional judgment.

Rapid identification of learner needs. AI can analyze large volumes of responses in a short period, which is particularly useful in large classes.

Adaptation to individual learning pace. Learners can revisit necessary material or proceed to the next stage when ready. Saving teacher time. Automated checking, responses to routine questions, individual exercise generation, and preliminary analysis can reduce administrative workload and allow teachers to focus on communication, motivation, creativity, guidance, and individual consultation.

Inclusive learning opportunities. Text-to-speech, speech-to-text, captioning, text

simplification, and translation can support learners with different educational needs. Development of independent learning. A well-designed AI tool should encourage learners to ask questions, investigate, and analyze their own mistakes rather than simply provide ready-made answers. OECD emphasizes that the educational value of AI and digital technologies depends not simply on the technology itself, but on the pedagogical purpose for which it is used [4]. AI should therefore be regarded as an instrument serving clearly defined educational objectives. Teacher competence is therefore a central condition for responsible AI use. A teacher needs not only technical knowledge of AI tools but also the ability to formulate appropriate prompts, evaluate generated information, recognize hallucinations or unsupported claims, protect personal data, and determine when technology should not be used. AI literacy should consequently be considered part of broader professional and digital competence.

Future research should examine the effectiveness of AI-supported personalization in specific educational subjects and age groups, including primary education. Empirical studies could compare different forms of adaptive feedback, investigate changes in learner motivation and achievement, and identify the conditions under which AI support produces sustainable learning gains. Such research would provide a stronger evidence base for the responsible integration of AI into Uzbek educational practice. Academic integrity in the age of generative AI requires a shift from assessing only the final product toward assessing the learning process. Teachers can ask learners to explain their reasoning, document stages of work, compare alternative answers, identify errors in AI-generated content, and defend their conclusions orally. Such tasks make the learner's own contribution more visible and simultaneously develop critical digital literacy.

Generative AI can produce reports, essays, and coursework. If a learner submits such material as entirely their own work, this conflicts with principles of academic integrity. At the same time, a complete ban on AI is not necessarily an effective solution. A responsible approach may include the following measures: requiring

learners to disclose their use of AI, explaining which parts were written independently and where AI was used, assessing outlines, evidence analysis, reasoning, and personal conclusions rather than only finished text, using oral defense or practical tasks, requiring verification of sources, AI should not reduce the role of the teacher. The teacher is an educator, motivator, organizer of communication, and specialist who supports learners' personal development. The U.S. Department of Education likewise emphasizes that AI in education should expand teachers' capabilities rather than replace them [5]. Equitable infrastructure is equally important. AI-supported personalization can be effective only when learners have reliable access to devices, connectivity, digital platforms, and appropriate technical support. Therefore, technological implementation should be accompanied by teacher training, institutional support, data-protection mechanisms, and measures aimed at reducing digital inequality.

Another important direction is the development of culturally and linguistically appropriate AI resources. Educational systems trained predominantly on other languages and cultural contexts may not always provide sufficiently accurate examples, terminology, or explanations for Uzbek-speaking learners. Developing high-quality Uzbek-language educational corpora can therefore contribute not only to technological development but also to the preservation and modernization of the Uzbek language in digital education. In Uzbekistan, the Strategy for the Development of Artificial Intelligence Technologies until 2030 was approved by Presidential Resolution No. PQ-358 dated October 14, 2024 [6]. This provides an important legal basis for introducing AI into different sectors, developing data infrastructure, and preparing modern specialists. First direction — expanding Uzbek-language educational datasets. High-quality datasets consisting of Uzbek-language textbooks, explanatory dictionaries, curricula, tests, video lessons, and scholarly articles should be developed. Second direction — developing teachers' AI competencies. UNESCO's 2024 AI Competency Framework for Teachers identifies knowledge, skills, and values that teachers need to use AI responsibly [7]. Teachers

should understand AI capabilities, recognize its limitations, protect data, design tasks with AI assistance, assess learner work fairly, and verify AI-generated outputs.

Personalizing the educational process through artificial intelligence is an important direction of contemporary education. AI can help identify learners' knowledge levels, create individual learning pathways, adapt task difficulty, provide timely feedback, and offer analytical support to teachers. However, AI does not automatically improve educational quality. Three conditions are essential: it must serve a clear pedagogical objective; teacher supervision must be maintained; and learner data and human rights must be protected. For Uzbekistan, an appropriate approach is to introduce AI gradually, on a research-based foundation, and in accordance with local educational needs. Expanding Uzbek-language educational content, developing teachers' AI competencies, improving school digital infrastructure, and updating academic integrity principles are key conditions. When properly organized, AI does not replace the teacher. Instead, it can enable teachers to understand each learner's needs more deeply, plan instruction more precisely, and support individual learner development.

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