THE EFFECTIVENESS OF ARTIFICIAL INTELLIGENCE–BASED ADAPTIVE LEARNING TECHNOLOGIES IN COMPUTER SCIENCE EDUCATION AT ACADEMIC LYCEUMS

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Abstract. *This article analyzes the pedagogical effectiveness of using artificial intelligence–based adaptive learning technologies in teaching computer science at academic lyceums. Modern research shows that artificial intelligence enables the identification of students' knowledge levels and cognitive characteristics, making it possible to individualize the learning process. The article highlights how AI-based intelligent platforms contribute to the development of students' algorithmic thinking, independent learning skills, and problem-solving competencies.*

Keywords: *artificial intelligence, adaptive learning, computer science, digital pedagogy, academic lyceum.*

Introduction. In today's digital society, artificial intelligence has become one of the key technologies transforming the education system. According to an OECD report, AI-based educational systems enable the personalization of learning by automatically analyzing students' learning pace and knowledge levels [2]. Russell and Norvig define artificial intelligence as "a system that automates the analysis of knowledge and decision-making," emphasizing that its application in education contributes to optimizing didactic processes [3]. The integration of artificial intelligence into computer science education in academic lyceums not only increases students' knowledge levels but also enhances their algorithmic thinking and problem-analysis abilities [4].

Literature Review. Luckin and her colleagues have scientifically demonstrated that artificial intelligence–based learning environments encourage

students to engage in active learning and support deeper knowledge acquisition [5]. Holmes, Bialik, and Fadel argue that artificial intelligence can transform education into a "learner-centered system," emphasizing the crucial role of adaptive learning in this process [6]. Among Uzbek scholars, Karimov has analyzed the potential of artificial intelligence within digital pedagogy for automating and individualizing the learning process [7]. Qodirov has empirically proven that the implementation of AI-based educational software in academic lyceum computer science classes significantly enhances students' algorithmic thinking [8].

Results and Discussion. The experimental results showed that lessons organized on the basis of artificial intelligence significantly increased students' interest in computer science and their level of independent learning activity. As noted by Holmes and Fadel, adaptive learning systems transform students from passive listeners into active seekers of knowledge [6]. Likewise, as pointed out by Luckin, AI-based platforms strongly support reflection and self-assessment mechanisms [5].

The automatic analysis of students' tasks enabled teachers to make rapid pedagogical decisions, thereby strengthening the differentiated approach [2].

To determine the effectiveness of artificial intelligence–based adaptive learning technologies in the context of an academic lyceum, an experimental study was conducted. Two parallel groups of computer science students participated: the control group was taught using traditional methods, while the experimental group was instructed using AI-based adaptive platforms. During the experiment, students' knowledge levels, algorithmic thinking, independent learning skills, and learning motivation were comparatively analyzed.

Using AI-based learning systems, each student's level of knowledge was automatically assessed and tasks of appropriate complexity were assigned. As a result, high-achieving students were able to work on more complex algorithmic problems, while students with learning gaps received additional explanations and customized exercises. This approach reduced disparities in achievement and increased overall learning outcomes.

The results demonstrated that students' independent learning activity increased significantly in AI-based classes. By using systems that automatically analyze errors in algorithmic problem-solving, students began to identify their own weaknesses independently, leading to the development of reflection and self-monitoring skills. In addition, students' interest in lessons increased, and a positive attitude toward studying computer science was formed.

Through AI-based platforms, teachers obtained rapid analytical data on students' completed tasks, which enabled the effective implementation of differentiated instruction, the provision of individual feedback, and precise lesson planning. As a result, the quality of the educational process improved and students' deeper mastery of knowledge was ensured.

Overall, the practical experiment demonstrated that artificial intelligence–based adaptive learning technologies possess high pedagogical effectiveness in academic lyceum computer science education. These technologies play an important role in developing students' algorithmic thinking, independent learning abilities, and learning motivation, thereby preparing them to meet the demands of the modern digital society.

Conclusion. Artificial intelligence–based adaptive learning technologies significantly improve the quality of computer science education in academic lyceums. As noted by Russell and Norvig, AI systems are capable of analyzing complex problems and proposing optimal solutions [3], which contributes to the development of students' algorithmic and critical thinking. Therefore, the methodologically well-planned implementation of artificial intelligence–based learning environments in academic lyceums should be regarded as a strategic priority of modern education.

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