Pedagogical and Methodological Capabilities of Artificial Intelligence Tools in Developing Digital Literacy

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Keywords: Digital Literacy, Artificial Intelligence, Educational Technologies, Higher Education Innovations, Statistics and Data Analysis, Econometric Modeling, Interactive Learning Environments.

Abstract: Artificial intelligence (AI) technologies have ushered in a new era in the development of students' digital competence in higher education. This article analyzes the pedagogical and methodological capabilities of AI tools and provides an in-depth look at their impact on students' ability to search, process, analyze information, and develop digital competence. The relevance of the study is explained by the need to develop digital competence in line with the requirements of the global labor market. A mixed methodological approach was used, and the effectiveness of AI-integrated lessons was evaluated in experimental and control groups. The quantitative phase included tests based on DigComp 2.2 indicators, while the qualitative phase included in-depth interviews with teachers and focus group discussions. The results showed that AI-based lessons had a significant positive impact on students' personalized learning paths, problem-solving skills, and motivation. The role of AI tools in enhancing personalized learning, optimizing formative assessment through real-time learning analytics, and developing a culture of digital safety was scientifically explained. At the same time, limitations such as data privacy, academic integrity, and teacher digital readiness were also highlighted. These comprehensive research results provide practical recommendations for improving national and international educational strategies aimed at effectively developing digital literacy in modern higher education systems.

1 INTRODUCTION

In recent years, the concept of "digital competence" has been recognized globally as one of the most important pedagogical, professional and social skills. The rapid development of the digital economy, new labor market requirements, as well as the expansion of distance learning in the post-pandemic period, have made this competence a vital necessity for every citizen, especially higher education students. Students should not only be able to search for or use information, but also to critically evaluate it, manage it in a safe environment, and creatively re-purpose it.

The DigComp 2.2 model (2022) developed by the European Commission defines digital competence through five main dimensions: information processing, digital communication and collaboration, content creation, security, and problem solving, interpreting it as a socio-cultural phenomenon, not just a technical one [1].

Therefore, the development of digital competence is becoming a priority for modern education. It is also recognized as one of the most important pedagogical, professional and social skills in the education system of Uzbekistan. The rapid development of the digital economy in the country, the gradual implementation of the "Digital Uzbekistan - 2030" strategy [2], as well as the expansion of distance learning after the pandemic, have brought this competence to the level of a vital necessity for every student. The Resolution of the President of the Republic of Uzbekistan, Resolution No. PD-320 dated October 30, 2025 "On additional measures to support projects based on artificial intelligence technologies" [3] and the Concept of "Digital Education" adopted in 2022 [4] require in-depth mastery of ICT in higher education institutions. These documents have made the development of students' skills in working with information, ensuring digital security, collaboration, and participation in innovative projects a priority of state policy.

Artificial intelligence (AI) technologies are taking this process to a new level. Uzbekistan has been taking consistent steps in AI in recent years: in 2021,

the “National Strategy for the Development of Artificial Intelligence for 2021-2030” was approved by Presidential Decree, and in 2022, the Center for Artificial Intelligence was launched in Tashkent. Along with research, these centers are engaged in the integration of AI into the education system and the implementation of practical projects in collaboration with higher education institutions. As a result, a number of universities - including Tashkent State Pedagogical University, Urgench State Pedagogical Institute, and Tashkent University of Applied Sciences - are piloting AI-based learning platforms, such as adaptive testing systems, intelligent chatbots, and learning analytics modules. However, this process also raises a number of pressing issues.

Ensuring the confidentiality of student data, the transparency of algorithmic decisions, the level of preparation of teachers for the effective use of AI technologies, and the integration of AI tools into the didactic process require a special scientific approach. Therefore, the integration of AI in Uzbekistan needs to be carefully planned not only from a technological perspective, but also from a pedagogical, psychological, social, and legal perspective.

2 METHODOLOGY

One of the important tasks facing the modern education system, and in particular higher education institutions, is to prepare students for successful functioning in the digital age. In this process, the digital learning environment is one of the key factors. It is not enough to understand it simply as consisting of computers and the Internet; the digital learning environment is a much broader and more complex system that includes the integration of information resources, communication tools, pedagogical technologies, and management mechanisms.

The system of stages presented in the Figure 1 reflects the evolutionary development of students in the digital environment. Although the fourth stage - “Digital literacy” - has the same name as the general process, it conceptually serves as the practical implementation point of the entire system. That is, while the first three stages (information sorting and security) form skills of a mainly theoretical and protective nature, the fourth stage directly moves on to the effective use of digital devices and applications for specific purposes. Therefore, this stage should be interpreted as the central link of the entire model. Only after reaching the fourth level, the student begins to form higher-level competencies such as creating multimedia content (stage 5) and managing information in compliance with the rules of digital culture (stage 6).

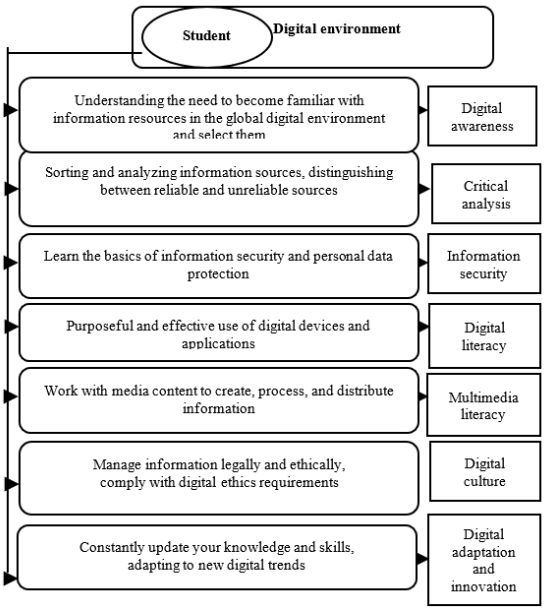


Figure 1: Stages of developing a student's digital literacy.

The final stage requires constant updating and innovative adaptation, transforming digital literacy from a static state into a dynamic skill.

Today, the role of artificial intelligence (AI) technologies in education in further improving this system is unparalleled. Artificial intelligence-based systems allow you to identify the individual learning needs of students, analyze their level of knowledge in real time, and offer customized educational content. This will take the formation of competencies such as digital awareness, critical analysis, information security and digital literacy to a new level, as shown in the Figure 1. The rapid and widespread use of artificial intelligence technologies in world practice and the availability of such digital information in our country are today’s requirements, ensuring high-quality use in life, creating favorable conditions for training qualified personnel in this field.

When writing the article, the methods used were: study and analysis of scientific and methodological literature on artificial intelligence tools in developing students' digital literacy in higher education institutions, questionnaires, interviews, pedagogical observation, synthesis and design, compilation of analytical tables, experimental testing, as well as statistical and mathematical analysis of data in accordance with the goals and objectives of the research.

3 LITERATURE ANALYSIS

The scope of using artificial intelligence (AI) tools in developing students' digital literacy in higher educational institutions of Uzbekistan and foreign countries is expanding. This process is not only the result of technological progress, but also an integral part of the modern pedagogical and information environment. Today, the digital educational environment, integrated with artificial intelligence, is taking students' opportunities for knowledge acquisition, analysis and creative activity to a new level. In this regard, the formation of digital literacy in students is not only a requirement of the time, but also a strategic task of the continuous education system.

The criteria and requirements developed for identifying, developing, and assessing students' digital potential in modern education have been reflected in international and national research. In particular, the approach put forward by Zhukova N.A. emphasizes that the formation of digital literacy is carried out through a system of basic competencies, in which the skills of searching, analyzing, processing, and critically evaluating information play a key role [5]. These competencies will be further improved in combination with artificial intelligence tools, as AI technologies allow for the rapid processing of large amounts of data, the extraction of important information, and the provision of individual recommendations.

The concept developed by Douglas A.J. Belshaw interprets digital literacy as a system of eight interrelated elements. Each component of this model - cultural, cognitive, constructive, communicative, trustworthiness, creativity, criticality, and citizenship - takes on new meaning in a digital environment enriched with artificial intelligence [6]. For example, AI-based platforms support students' cognitive performance, making it easier to understand and analyze complex information, while expanding the possibilities for creating new content through creative tools. However, in this process, the importance of critical and civic competences will increase even more, as assessing the reliability and ethical aspects of information generated by AI becomes an important task.

The “capabilities - skills - practical activities - personality” model proposed by R. Sharp and H. Bifham also receives a new interpretation in the context of artificial intelligence [7]. AI technologies initially create broad opportunities for students, and then, based on these opportunities, the necessary digital skills are formed, which are used in practical activities and ultimately determine the digital identity and competence of the individual. Thus, artificial intelligence acts as a catalyst in the process of developing digital literacy. At the same time, modern research shows that it is wrong to limit digital literacy only to technical skills. According to the definition given by V.A. Sukhomlin, E.V. Zubareva and A.V. Yakushin, digital skills are a dynamic, contextual and inextricably linked system of professional activity [8]. This approach is especially relevant in the context of artificial intelligence, since working with AI tools requires not only technical knowledge, but also analytical thinking, flexibility and ethical responsibility.

The rapid development of artificial intelligence technologies, while increasing efficiency in the educational process, also poses certain risks and challenges. As Whittaker et al. (2018) point out, the ethical implications of automation through AI may not be sufficiently taken into account [9]. Therefore, it is necessary to strictly adhere to the principles of fairness, transparency and accountability in the use of AI tools.

In recent years, the rapid growth of AIED (Artificial Intelligence in Education) research has further strengthened the importance of AI in education. Research findings show that AI technologies have a positive impact on learning outcomes, expanding scholarly activity, and increasing interdisciplinary integration.

The introduction of artificial intelligence (AI) technologies into the education system is shaping new scientific approaches to developing students' digital literacy [10]. First of all, empirical research shows that educational processes organized on the basis of SI have not yet fully transitioned to a competency-based approach [11]. In particular, a study based on the analysis of 98 lessons found that the majority of SI lessons were conceptual (50%) and partially experimental (31.63%), while the development of higher-level cognitive skills was observed in only 35.71% of cases. [11] It was also found that the ethics of SI were very poorly covered (5.1%) in this study [11].

Other theoretical perspectives interpret SI as a paradigm-shifting factor in education [12]. According to this approach, SI increases the possibility of individualizing education, increasing flexibility, and making informed decisions [12]. At the same time, researchers emphasize the priority importance of critical thinking and ethical competencies in the process of using SI tools [12].

Practical pedagogical research suggests new methodological approaches to the use of SI tools. In

particular, research based on the “reperformance” and “critical error review” models has shown that students achieve deeper learning through independent verification and analysis of the results generated by SI [9]. This approach develops high-level competencies in students [9].

At the same time, modern research also emphasizes that the effectiveness of SI technologies is directly dependent on the digital and pedagogical competencies of teachers. [13] Empirical research on the use of generative AI tools shows that teachers' level of AI literacy and understanding of its pedagogical value determines their intention to introduce these technologies into the educational process [13].

However, there are also risks associated with the use of AI. It is no coincidence that the European Union's "AI Law" classifies AI systems used in education as "high risk". Because such systems, if misused, could undermine the right to education, increase discrimination or deepen existing social inequalities.

Therefore, the use of artificial intelligence in the process of developing students' digital literacy requires an integrative approach. That is, along with technological capabilities, ethical, social and legal aspects must also be taken into account. As a result, the digital literacy model based on artificial intelligence in the higher education system ensures not only the professional competence of students, but also their formation as responsible, critical, and innovative thinkers.

4 RESULTS AND DISCUSSION

The results of the study confirmed the effectiveness of the savodxonmedia.uz e-learning platform, supported by artificial intelligence, in developing students' digital literacy. A comparison of the results of the experimental and control groups showed that the AI-integrated learning environment significantly increases not only students' technical skills, but also their analytical and critical thinking competencies.

The main innovation of the proposed platform is that, unlike traditional learning management systems, it creates a special didactic environment focused exclusively on the development of digital literacy and related competencies. The platform organizes educational materials for the subjects “Application of Information Technologies in Professional Activities” and “Media Literacy and Information Culture” in higher pedagogical educational institutions of Uzbekistan on the basis of a single integrated system.

This integration ensures the continuity of the educational process and allows students to comprehensively master theoretical knowledge and practical skills. The results of the study showed that classes organized on the basis of interdisciplinary integration significantly develop students' skills in working with information, analyzing it, and evaluating it.

One of the important components of the platform is the AI-based recommendation module. This module generates individual recommendations based on the user's:

- learning activity;
- learning results;
- history of activity in the system.

The results of the study showed that AI-based recommendations:

- increased students' learning motivation;
- developed self-assessment and reflection skills;
- enhanced the effectiveness of independent learning.

In particular, it was found that the role of the AI module is important in helping students analyze their level of knowledge and identify areas for further development. This, along with automating the learning process, serves to develop metacognitive skills.

The platform's main functional digital tools are integrated into a single ecosystem. This system includes the following components:

- learning content management module (lectures, slides, practical exercises);
- assessment and monitoring system;
- AI-based recommendation module;
- learning analytics tools that analyze user activity.

The integration of these components ensures the continuity and efficiency of the learning process. Based on the data obtained through learning analytics tools, teachers have the opportunity to monitor the dynamics of student development and adjust learning strategies. In order to determine the level of effectiveness of the proposed methodology within the framework of scientific research, a pilot-testing process will be organized. 450 1st and 2nd year students of higher pedagogical educational institutions of the Republic of Uzbekistan in Tashkent and Urgench were involved in the pilot-testing work in 2024-2025. In the process of implementing the pilot-testing work of the research, the following regulatory documents were compiled and educational and methodological resources were developed:

1) Educational program, curriculum for the subjects "Application of information technologies in professional activities" and "Media literacy and information culture" of higher educational institutions of pedagogical sciences.
2) Instructions for carrying out theoretical and practical work used in AI-based education, practical assignments, audio and video manuals, etc.
3) Control and test tasks used to assess the acquired knowledge of learners.
4) Mathematical statistical methods and questionnaires to determine the effectiveness of AI-based education.

The pilot study was carried out in three stages: foundational, educational and explanatory:

1) At the foundational stage, the pilot study sites were identified; the number of respondents was determined; experimental and control groups were formed; the pilot study was organized; a pilot study program was developed.
2) At the educational stage, pilot testing was carried out; preliminary examination of the effectiveness of the developed methodology; based on the results of the experiment, work was carried out to enrich the content of lecture texts, practical and laboratory assignments to improve the existing methodological support.
3) At the clarifying experimental stage, during the pilot testing, the results of teaching the subjects "Application of Information Technologies in Professional Activities", "Media Literacy and Information Culture" using an AI-based platform were summarized, the conclusions obtained were practically verified, and these results were analyzed using the Student-Fisher T-criterion mathematical and statistical method

For the effective use of mathematical-statistical formulas, the mastery levels in the experimental group are represented as x_i , the corresponding numbers of learners are denoted by n_i and the statistical probabilities as $p_i = \frac{n_i}{N}$ and similarly, the corresponding variables for the control groups as y_i, m_i va $q_i = \frac{m_i}{M}$ are denoted by. The results of the mastery in the experimental group were conditionally divided into two statistical samples, and the arithmetic mean values, dispersion and variation coefficients of the samples were determined for each of the two samples.

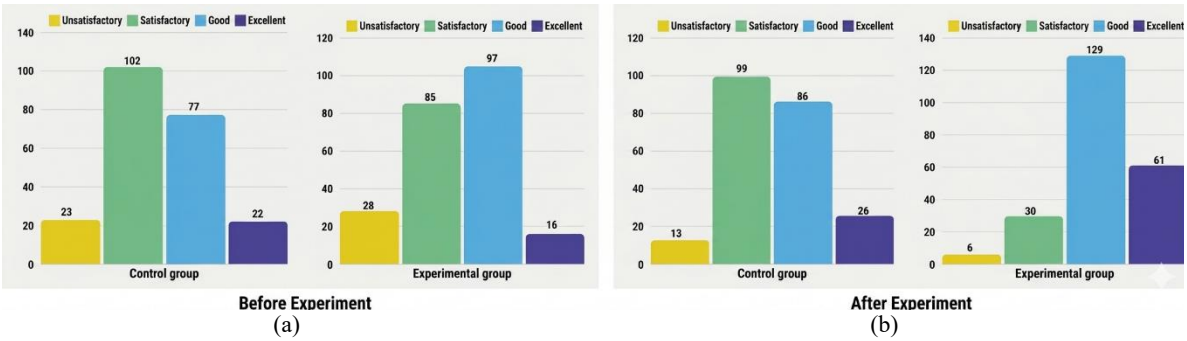
The learning dynamics of the 450 students who participated in the experimental test at the beginning and end of the experiment are presented in the figure below (see Table 1 and Fig. 2).

As can be seen from Figure 2, it can be predicted that the sample modal values for the experimental and control classes satisfy the conditions $\bar{X} > \bar{Y}$ for the experimental group, respectively. They are calculated using this formula:

$$\bar{X} = \frac{1}{n}\sum_{i=1}^{n} n_i x_i = \frac{1}{226}(5 * 61 + 4 * 130 + 3 * 29 + 2 * 6) = 4{,}08.$$

Table 1: Student achievement indicators.

	Experiment group i					Control group				
	X_i	5	4	3	2	Y_j	5	4	3	2
Experience first	n_i=226	16	87	95	28	n_j=198	22	77	102	23
The experience is the last.	n_i=198	61	130	29	6	n_j=198	26	86	105	10



(a) (b)

Figure 2: Diagrammatic representation of the results of experimental and test work: a) Initial experience, b) After the experiment.

$$\overline{Y} = \frac{1}{n}\sum_{i=1}^{n} n_i y_i = \frac{1}{224}(5 * 26 + 4 * 86 + 3 * 105 + 2 * 10) = 3{,}55.$$

When looking at the values, it is clear that the average achievement in the experimental group is higher than the results of the control class: $\overline{X}>\overline{Y}$.

$$\frac{\overline{X}}{\overline{Y}} = \frac{4{,}08}{3{,}55} = 1{,}15.$$

The experimental results confirmed the effectiveness of using artificial intelligence-based learning platforms in the educational process and showed an increase of 15%.

The study revealed that students have different levels of digital literacy. Based on this, a mechanism for forming individual learning trajectories was introduced on the platform. The results showed that:

- basic digital skills were developed for elementary level students;
- intermediate level students developed information processing and systematization skills;
- advanced level students deepened their competencies in critical evaluation of media content and safe use.

This confirms that the platform effectively implements differentiated and person-centered learning.

The ethical deployment of AI within the platform is governed by three core principles: data minimization, which ensures students' identities are decoupled from performance logs to avoid bias; algorithmic transparency, providing students with awareness of AI-generated insights to foster independent decision-making; and bias mitigation, achieved through regular audits that prevent "filter bubbles" and ensure dynamic access to learning materials for all students regardless of their initial performance level.

The empirical findings of this study further distinguish the proposed system from existing educational solutions. A comparative analysis shows that while global platforms like Coursera or Khan Academy utilize AI for general content recommendation, savodxonmedia.uz offers a more specialized didactic environment specifically mapped to the national pedagogical standards of Uzbekistan. Unlike generic AI tutors, our platform's AI-based recommendation module is uniquely integrated with a dual-subject framework (IT Application and Media Literacy), allowing for cross-disciplinary competency mapping that is often missing in broader e-learning systems. This context-specific integration constitutes the primary novelty of the proposed system, as it bridges the gap between general digital skills and local academic requirements.

5 CONCLUSIONS

In conclusion, the savodxonmedia.uz e-learning platform, integrated with artificial intelligence tools, has demonstrated high pedagogical effectiveness in developing students' digital literacy. In particular, the implementation of individual learning trajectories, the use of an AI-based advisory module, and the presentation of educational content in an integrated didactic system have significantly improved students' problem-solving, critical thinking, information analysis, and independent learning competencies. Also, real-time monitoring of the learning process through learning analytics tools has proven to be an important factor in improving the quality of education and ensuring an individual approach.

The integration of AI tools within the platform is methodologically grounded in their ability to provide predictive scaffolding for specific subjects, such as identifying technical gaps in IT applications and analyzing media evaluation patterns. Furthermore, the ethical deployment of these tools is strictly managed through data minimization to protect student identities, algorithmic transparency to prevent over-reliance on AI, and periodic bias audits. These measures ensure that the AI-driven recommendation engine serves as a pedagogically sound and responsible instrument for personalized learning.

At the same time, the research results showed that the effectiveness of an artificial intelligence-based learning environment largely depends on the methodological approach and digital competence of teachers. The widespread use of AI tools in the educational process raises the need to address issues such as data security, academic integrity, and pedagogical oversight. Therefore, in the future, it is important to develop not only technological, but also didactic and ethical aspects in an integrated approach to improving educational platforms aimed at developing digital literacy.

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