



DIDACTIC OPPORTUNITIES OF THE DIGITAL AND ARTIFICIAL INTELLIGENCE ENVIRONMENT IN DEVELOPING STUDENTS' RESEARCH SKILLS

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Abstract: *This article provides a scientifically grounded analysis of the didactic opportunities of digital technologies and artificial intelligence (AI) environments in developing the research skills of students in pedagogical education programs. The study examines the integration of AI tools into the educational process, their impact on cognitive and practical competencies, and the results of an experimental study. The findings demonstrate that digital and AI environments significantly enhance students' independent research activity.*

Keywords: *artificial intelligence, digital education, research competence, pedagogical technologies, higher education, innovative approach.*

INTRODUCTION

In modern higher education systems, the formation of students' research competence is of strategic importance. The Law of the Republic of Uzbekistan "On Education" defines the necessity of introducing modern pedagogical technologies and information and communication tools into the educational process, as well as developing independent thinking [1]. Similarly, the Law "On Science and Scientific Activity" identifies the involvement of young people in research and the development of scientific potential as a priority of state policy [2]. In the context of digital transformation, the modernization of the education

system is defined as a priority direction in the "Digital Uzbekistan – 2030" Strategy, which emphasizes the implementation of artificial intelligence and digital technologies across all sectors, including education [3]. In addition, Presidential Decree PQ-2909 on the development of higher education highlights the need to strengthen students' research activities, introduce innovative technologies, and develop competencies [4].

METHODS

The study was designed within the framework of a competency-based and activity-oriented approach, which ensures not only the acquisition of theoretical knowledge but also the development of practical research skills through active



student engagement. The competency-based approach focused on the formation of key research competencies (analytical, critical thinking, and methodological skills), while the activity-oriented approach emphasized learning through performing real research tasks, problem-solving, and independent inquiry.

Research Design. A mixed-method research design was employed, combining both qualitative and quantitative methods to ensure the reliability and validity of the findings. The study included the following methods:

- *Theoretical analysis* – used to examine scientific literature, нормативные документы, and existing approaches to the integration of artificial intelligence and digital technologies in education. This stage helped to define the conceptual framework and research criteria.

- *Pedagogical experiment* – conducted to test the effectiveness of AI and digital tools in developing students' research competence under controlled conditions.

- *Observation* – systematic monitoring of students' learning activities allowed for the identification of behavioral changes, engagement levels, and the development of independent learning skills.

- *Survey (questionnaire)* – administered to collect students' perceptions, attitudes, and self-assessment regarding the use of AI tools and their influence on research skills.

Participants. The study involved 120 undergraduate students enrolled in pedagogical education programs. The participants were selected using a purposive sampling method to ensure comparable academic backgrounds. They were divided into two groups: Experimental group (n = 60) – students who participated in the learning process enhanced by AI and digital technologies, Control group (n = 60) – students who were taught using traditional instructional methods without the integration of AI tools.

Both groups were comparable in terms of prior academic performance, age, and level of digital literacy at the initial stage of the experiment.

Intervention and Learning Tools. In the experimental group, the educational process was enriched through the systematic integration of AI-based and digital tools:

- Academic search platforms (Google Scholar, ResearchGate) were used to develop students' skills in finding and selecting relevant scientific sources.

- AI-powered tools (ChatGPT and NLP-based text analysis systems) supported idea generation, text structuring, paraphrasing, and preliminary data interpretation.

- Learning Management System (Moodle) facilitated the organization of course materials, assignment submission, feedback, and online collaboration.

- Statistical software (SPSS) was applied to teach students the basics of



quantitative data analysis and interpretation of research results.

The instructional process included tasks such as formulating research questions, conducting literature reviews, analyzing data, and preparing academic texts.

In contrast, the control group followed a traditional approach, which included lectures, seminars, textbook-based learning, and standard written assignments without the use of advanced digital or AI tools [5].

Assessment Criteria and Data Collection. The level of students' research competence was assessed using a set of criteria-based indicators, evaluated at both the initial (pre-test) and final (post-test) stages of the experiment:

RESULTS

The experimental results showed a significant improvement in research

Table 1.

Level	Initial	Final
High	32%	68%
Medium	46%	25%
Low	22%	7%

According to the results, students who used AI tools were able to identify scientific problems more quickly, effectively analyze large volumes of data, and improve academic writing skills. This confirms the importance of the digital environment in enhancing cognitive activity [7].

DISCUSSION

1. Identification of scientific problems – the ability to formulate relevant and meaningful research questions.

2. Information analysis – the ability to search, critically evaluate, and synthesize scientific information.

3. Conclusion drawing – the ability to interpret findings logically and formulate evidence-based conclusions.

4. Independent research activity – the ability to plan and conduct research tasks autonomously[6].

Each criterion was assessed using a three-level scale (high, medium, low), based on predefined descriptors and performance indicators.

competence in the experimental group. The research results are presented in Table 1.

The findings of the study confirm that the integration of digital technologies and artificial intelligence (AI) into the educational process creates favorable conditions for the effective development of students' research competence. The results obtained in the experimental group demonstrate not only quantitative growth in competence levels but also qualitative



changes in students' learning behavior, cognitive activity, and independence.

One of the key outcomes of the study is the enhancement of individualization in learning. AI-based tools made it possible to adapt educational content and tasks to the individual needs, abilities, and pace of each student. This aligns with contemporary pedagogical theories that emphasize learner-centered education and personalized learning trajectories. Students in the experimental group showed greater engagement and motivation, as they were able to work with resources and tasks tailored to their level of preparedness.

Another important aspect revealed by the study is the increase in cognitive and analytical activity. The use of digital platforms and AI tools facilitated access to large volumes of academic information and enabled students to process, compare, and critically evaluate data more efficiently. As a result, students developed stronger analytical thinking skills and demonstrated improved ability to identify relationships, patterns, and research problems. This supports the idea that digital environments contribute significantly to the development of higher-order thinking skills.

The study also highlights the role of AI in fostering reflective competence. Through interaction with digital tools, students were able to receive immediate feedback, analyze their own performance, and make necessary adjustments in their learning strategies. This process of

reflection is essential for the development of independent researchers, as it encourages self-regulation and continuous improvement. A particularly significant finding is the improvement in students' ability to formulate scientific problems and conduct independent research. AI-based systems assisted students in structuring ideas, generating research questions, and organizing academic texts. Consequently, students became more confident in initiating and conducting research activities, which is a critical component of professional training in pedagogical education.

At the same time, the study identified several challenges and limitations associated with the use of AI in education. One of the major concerns is the risk of academic dishonesty, as students may rely on AI-generated content without proper understanding or attribution. In addition, overreliance on AI tools may reduce students' ability to think critically and independently if not properly guided by instructors. Another issue is the insufficient level of digital competence among educators, which can hinder the effective implementation of AI technologies in the teaching process.

These findings are consistent with international research, which emphasizes that while AI has significant potential to transform education, its implementation must be accompanied by clear pedagogical strategies and ethical guidelines. In particular, the importance of maintaining academic integrity, developing digital literacy, and ensuring



responsible use of AI tools is widely recognized.

Furthermore, the results suggest that the effectiveness of AI integration largely depends on the pedagogical design of the learning process. Simply introducing digital tools is not sufficient; it is essential to align them with learning objectives, assessment criteria, and instructional methods. Teachers play a crucial role in guiding students' interaction with AI, ensuring that technology serves as a tool for learning rather than a substitute for intellectual effort. In summary, the discussion of the results indicates that digital and AI environments have substantial didactic

potential in developing research competence. However, their successful application requires a balanced approach that combines technological innovation with pedagogical support, methodological rigor, and ethical responsibility.

CONCLUSION

In conclusion, the research findings indicate that digital and AI environments enhance research competence and support the activation of independent scientific activity. Therefore, it is important to integrate these technologies into the educational process by incorporating AI tools into curricula, organizing digital training programs for teachers, and strengthening academic integrity systems.

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