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PEDAGOGICAL AND TECHNOLOGICAL FOUNDATIONS OF INTEGRATING ARTIFICIAL INTELLIGENCE TOOLS INTO PRACTICAL CLASSES

Annotation

In modern conditions, the strategic development of the education system is determined by the priority focus on the effective integration of digital technologies and artificial intelligence (AI) tools into the educational process. The integration of AI technologies allows not only to modernize the content of practical classes and teaching methods, but also to ensure the individualization of learning, prompt feedback and automation of a number of pedagogical functions. Such changes are directly related to the implementation of the principles of a personality-oriented approach aimed at developing the independence and cognitive activity of students.

The article presents a comprehensive analysis of the pedagogical and methodological foundations of the use of artificial intelligence tools in the educational practice of universities. In the course of the study, such platforms as ChatGPT, Wix ADI, Framer AI, Durable AI and others were tested, the use of which contributed to the enrichment of the content of practical tasks and increased the motivation of students. The developed model of AI integration includes three consecutive stages: preparatory (defining goals and selecting digital tools), training (organizing interactive activities for students) and evaluative and analytical (automated processing of results and providing individualized feedback).

The results of the pedagogical experiment confirmed that the systematic use of AI tools contributes to the growth of interest in the academic discipline, the activation of cognitive activity and the development of teamwork skills. The use of artificial intelligence technologies makes the educational process more flexible, adaptive, and focused on students' personal educational trajectories.

In conclusion, directions for further improvement of educational practice are proposed, including increasing the digital competence of teachers, the introduction of AI tools in educational and methodological complexes and the expansion of their use in research and project activities of students.

Keywords: artificial intelligence, practical classes, digital technologies, AI tools, ChatGPT, methodological model, higher education.

Introduction. The global educational space is currently undergoing a period of fundamental change associated with the development of digital technologies and the introduction of artificial intelligence (AI) systems into all spheres of life.

In the context of the information society, the main task of the education system is to adapt students to future professional activities, develop their personal abilities, creative potential and critical thinking. To solve this problem, the use of digital pedagogy and artificial intelligence tools is of particular importance. Artificial intelligence is a set of information technologies aimed at modeling human cognitive actions (analysis, learning, drawing conclusions, decision making). In the field of education, it can perform functions such as personalization of educational content, adaptation of teaching materials, automation of feedback, and prompt assessment of learning outcomes. At the present stage, artificial intelligence is considered as an effective tool for improving the quality of the educational process, adapting learning and increasing the educational activity of students [1].

Practical classes at higher education institutions develop student's ability to apply theoretical knowledge in practice and lay the foundation for professional competence. In such classes, students learn to make independent decisions, think analytically, and act creatively. However, traditional practical classes are often repetitive, meaning the teacher's guidance predominates and students' active cognitive activity is limited. From this perspective, integrating artificial intelligence tools into

practical classes can enhance the learning process by increasing its individualisation and effectiveness [2].

One of the conceptual guidelines of the modern education system is student-oriented education, aimed at taking into account the individual characteristics, the pace of assimilation and the level of training of each student. Artificial intelligence tools provide opportunities for the practical implementation of this approach: the student gets the opportunity to independently manage his educational route, while AI systems analyze his learning activity and form personalized recommendations. As a result, there is a rethinking of the traditional role of the teacher, who is transformed from a source of information into a facilitator, mentor and coordinator of individual educational trajectories of students [3].

In recent years, the integration of artificial intelligence technologies into the education system has been widely considered by domestic and international researchers. Tang's study, through an analysis of several articles, demonstrated the positive impact of AI tools on improving teaching effectiveness, enhancing student motivation, and developing cognitive activity [4]. Adaptive learning systems have been shown to tailor educational content to the individual characteristics of students, and intelligent learning systems are described as a means of providing personalized pedagogical support. Furthermore, it has been shown that the intellectualization of the digital educational environment contributes to the personalization of student learning activities and the development of reflective skills.

However, an analysis of scientific papers reveals that the pedagogical and technological foundations for integrating artificial intelligence tools into practical classes at higher education institutions are insufficiently systematized. While many studies focus on the use of AI in the general educational process, the transformation of practical class structures, the role of AI in developing students' professional competence, and its methodological justification are addressed fragmentarily. This gap underscores the relevance of this study.

The development of digitalization of education in Kazakhstan receives systematic support at the state level. In such strategic documents as the Digital Kazakhstan program and the Concept for the Development of Education for 2023-2029, the integration of artificial intelligence technologies and big data into the educational process is considered as one of the priority areas of state policy [5]. For the effective implementation of these tasks, it is necessary not only to modernize curricula, but also to improve the digital competence of teaching staff, ensuring methodological and technological readiness for the use of intelligent systems in educational activities.

Therefore, the introduction of artificial intelligence tools in practical classes is not just a technological innovation, but a change in the pedagogical paradigm. The emphasis of the educational process shifts from an explanatory and illustrative approach to research and applied format, where attention is focused on the activity, reflection and independence of the student. The use of AI allows students to analyze their own achievements, adjust individual learning strategies and thereby form a reflective culture of cognition.

The purpose of this study is to identify the pedagogical and technological foundations of teaching using artificial intelligence tools in practical classes at higher education institutions and to propose an effective pedagogical model by assessing its impact on student learning outcomes.

To achieve this goal, the following research questions were formulated:

RQ1. What are the pedagogical and technological prerequisites for integrating artificial intelligence tools into practical classes?

RQ2. How does the use of artificial intelligence tools influence student learning outcomes and their attitudes toward the learning process?

RQ3. What is an effective pedagogical model for integrating artificial intelligence tools into practical classes?

The object of this study is the process of conducting practical classes at higher education institutions. The scientific novelty of the study lies in the empirical assessment of the impact of integrating artificial intelligence tools into practical classes on the effectiveness of learning and the presentation of a component-based pedagogical model based on the results obtained.

Literature review. In modern pedagogical science, the problem of integrating artificial intelligence (AI) technologies into the educational space is considered one of the main directions of digital transformation of education. Researchers characterize AI not only as a technological innovation, but also as a complex socio-pedagogical phenomenon that changes the content, methodological and organizational structures of the education system.

Educational research shows that AI technologies are having a decisive impact on the individualization and adaptation of learning. Several studies have shown that adaptive learning systems modify content and enhance students' academic achievement according to their individual learning pace. Furthermore, a revolutionary advantage of AI tools can enable the automation of pedagogical diagnostics, rapidly improve learning outcomes, and create effective learning pathways.

Research shows that the use of AI tools enhances students' cognitive engagement and facilitates the integration of educational material. It's also worth noting that AI transforms the teacher's role, shifting it from a traditional knowledge-gathering function to a facilitator's role [6, 7].

The theoretical and methodological basis of the study is drawn from a number of scientific fields in modern pedagogy. According to the theory of constructivist learning, knowledge is not given ready-made, but rather is formed through the learner's active cognitive activity. These principles are based on the work of L.S. Vygotsky within the framework of social constructivism and developed in the research of J. Bruner within the field of cognitive constructivism [8]. In developing practical lessons, the theory of constructive coordination proposed by J. Biggs plays an important role. This concept aims to ensure alignment among learning objectives, teaching methods, and assessment tools, and artificial intelligence enables the technical implementation of this coordination [9]. Connectivism theory, which explains the networked nature of knowledge, offers a new direction for learning in a digital environment, where knowledge is formed through the interconnection of information sources [10]. In this sense, AI tools serve as an intelligent interface that connects students with the digital educational space.

The pedagogical potential of AI technologies is associated with four main components of the educational process:

1. The content component is the ability to adapt and automatically update educational material;
2. The operational component involves the interactivity and flexibility of teaching methods and tools;
3. The control and communication component involves the automation of feedback between students and teachers;
4. The motivational component aims to increase students' learning activity and stimulate independent learning.

Empirical studies conducted within these components show the positive impact of artificial intelligence tools on students' cognitive activity, motivation, and learning outcomes. For example, experiments at European universities have shown that AI-based grading systems speed up the review of written assignments and reduce faculty workload [11]. Educational institutions in Canada and Singapore have effectively used AI to organize student research activities, test hypotheses, and perform visual modeling [12, 13].

In the works of Rincón et al. and Jackson et al., it is noted that the use of AI develops critical thinking, self-regulation, and reflection skills in students [14, 15]. In the authors' study, more than 70% of students rated AI tools as useful and effective in the learning process.

In the work of Blagodelsky A.S., the effectiveness of using machine learning and deep learning methods in the field of web interface development was proved. The author analyzed the elements of visual design using neural networks and showed that HTML (HyperText Markup Language) and CSS (Cascading Style Sheets) codes can be automatically composed according to them [16]. This approach reduces programming time by 60-70% and greatly simplifies the creation of a web interface.

Kazakhstani studies have found that the use of AI technology increases students' learning motivation and interest in the subject. Furthermore, the use of digital tools in practical classes has been shown to promote the development of students' creative and visual literacy [17, 18].

Many international organizations, including UNESCO (the United Nations Educational, Scientific and Cultural Organization), the OECD (the Organization for Economic Co-operation and Development), and the World Economic Forum, have developed and adopted strategic documents aimed at the systemic integration of artificial intelligence tools into the educational sphere. For example, the OECD AI in Education Report, published in 2023, describes in detail the impact of AI technologies on the quality of education, including the nature of teacher-student interaction, teaching ethics, and aspects of academic integrity. The methodological foundations of digital pedagogy are systematized in theories of digital transformations in education and described in the principles of the DigCompEdu model for developing teachers' digital competencies [19]. The didactic logic of planning practical lessons is based on the concepts of constructive harmony, according to which learning goals, teaching methods, and assessment tools are mutually consistent.

Practical classes are an important didactic form in higher education, combining fundamental knowledge with expertise and developing professional competence. Therefore, the introduction of artificial intelligence tools into practical classes will allow for individualized learning, increased interactivity, and enhanced student independence. The integration of artificial intelligence tools into practical classes represents not only a technological upgrade but also a shift in pedagogical philosophy.

From a pedagogical point of view, AI technologies are used at all stages of the learning process: preparation (task generation, content selection), training (interactive tasks and modeling), and evaluation (automatic processing of results). This comprehensive approach increases the effectiveness of the learning process, reduces the burden on teachers and enhances student independence.

The results of empirical and theoretical-applied research indicate that the use of a set of artificial intelligence tools in educational practice contributes to the qualitative improvement of the educational process at several interrelated levels of pedagogical interaction.

Firstly, at the content(preparation) level, there is an in-depth assimilation of educational material due to its visualization, interactive presentation and dynamic structuring. The use of AI tools makes it possible to form more flexible trajectories of cognitive activity, ensuring the integration of theoretical content with practical tasks.

Secondly, at the methodological (training) level, an increase in the speed and efficiency of performing educational tasks is recorded. This is achieved through the automation of individual procedures for the analysis, search and interpretation of data, which, in turn, frees up the cognitive resources of students for more complex forms of intellectual activity, such as generalization, modeling and critical evaluation of information.

Thirdly, at the reflexive(evaluation) level, prerequisites for the development of metacognitive skills are formed, since the student gets the opportunity to analyze his own actions, compare the results with reference solutions and adjust the work strategy through AI systems. Thus, artificial intelligence performs not only an instrumental, but also a reflexive-motivational function, stimulating the development of independence and responsibility for learning outcomes.

Furthermore, researchers consider the ethical and methodological limitations of using AI. Issues of maintaining academic integrity, verifying information, and preventing learners from becoming dependent on technology dominate contemporary discourse [20]. The use of AI in education requires a pedagogically verified balance and methodological consistency that provides an optimal balance between technological support and traditional forms of cognitive activity.

The studies reviewed describe the impact of artificial intelligence on education and the professional environment from various perspectives. However, most of these studies do not consider the didactic, methodological, and technological foundations for the systematic implementation of AI tools in practical classes as a unified model, and their impact on learning outcomes is insufficiently empirically substantiated in the context of real-world learning activities. The resulting scientific problem is the lack of structured pedagogical approaches to the effective use of AI tools in practical classes. Addressing this gap is crucial for developing students' professional and digital competencies in higher education, as practical training is the key link between theory and professional practice.

Therefore, the research questions address the pedagogical model for implementing AI tools and how they impact learning effectiveness, which, in turn, is directly related to improving the quality of education in the context of modern digital transformation.

Methods and materials. The study was conducted in the first half of the 2025-2026 academic year at the L. N. Gumilyov Eurasian National University. Thirty-three 2nd year students of the Computer Science educational program took part in the experiment. Therefore, the study was conducted in a quasi-experimental design with repeated measures. This was done for the following reasons:

- Using each participant as their own control reduces the influence of individual differences;
- Increases statistical power in the case of small samples;
- Allows for a precise determination of the effect of the training intervention.

The study was organized in two stages. Developing a small website is a learning process that can be completed in a short period of time. During the control stage (week one), students created a website without using artificial intelligence tools, and during the experimental stage (week two), students were given tasks to create a website using artificial intelligence tools. The structure of the tasks in both stages was the same, but the topics were chosen differently. This approach was used to reduce the transfer effect of training and ensure the internal validity of the obtained results.

The training, which included the use of artificial intelligence tools in practical exercises, was divided into three stages:

1. *Preparatory stage.* The curriculum was analyzed, and the content of the practical lessons on website construction was restructured. During both weeks, each student was given assignments on defining a website theme, planning the structure, developing the design, and writing content. The difference was that during the experimental stage, students used freely available AI tools (ChatGPT, DeepSeek, Perplexity Wix ADI, Framer AI, and Durable AI) to complete the assignments.

2. *Training stage.* During the class, students created websites using the tools selected for the practical assignment. In the control phase, pupils created their websites without using artificial intelligence tools. In the experimental phase, pupils created their websites using the following artificial intelligence tools:

- ChatGPT — a natural language-based generative AI tool used for planning website structure, developing text content, editing content and generating ideas.
- DeepSeek — a generative language model with a built-in search engine, used for content creation.
- Perplexity AI — an AI-powered search engine that aggregates information from multiple sources and automatically provides links.
- Wix ADI — an AI platform for automatically creating websites based on the user's goals, audience and design preferences.
- Framer AI — an artificial intelligence tool for generating interface designs and visual mock-ups.
- Durable AI — a generative platform for creating websites that automatically generates the structure, text and visual elements of a site based on a brief description provided by the user.

The teacher acted as a moderator, providing exclusively methodological support, monitoring the completion of tasks and, where necessary, offering organisational advice. This role was chosen to ensure the objectivity of the experiment and to minimise external influences. At the end of the session, each student's contribution and level of knowledge were assessed.

3. *Evaluation stage.* A set of diagnostic tools was used to assess learning outcomes. Students' academic performance was assessed using a test consisting of 20 closed-ended questions. The questions are divided into four content blocks:

1) Website structure and planning (5 questions);
2) Web design fundamentals (5 questions);
3) organising web content (5 questions);
4) web interface and functionality (5 questions).

Each question had four answer options, only one of which was considered correct. The AI-based Quizizz platform was used for the test. Each correct answer was awarded 5 points, for a total maximum score of 100. The test results were used as a numerical indicator of the students' level of theoretical preparation.

The level of practical skills development was assessed using a specially developed rating scale for this topic. The assessment rubrics included the logical structure of the website, the quality of the visual design, the functionality of the interface, and the correctness of the content (Table 1).

Table 1. Rubric for Assessing Website Development Quality

Criterion (Max Points: 25)	**Excellent (22–25)**	**Good (16–21)**	**Satisfactory (9–15)**	**Poor (0–8)**
Logical structure of the website (0-25)	The structure of the site is complete, logical and systematic; the relationship between the departments is clear. navigation is convenient and intuitive.	The structure is essentially logical; there is a weak connection between some sections; navigation is convenient and intuitive.	The structure is partially organised; the links between sections are weak; there are difficulties with navigation.	The structure is disorganised; there is no connection between sections; navigation is unclear or non-existent.
Visual Design Quality (0–25)	The design is harmonious, contemporary and aesthetically pleasing; colours, fonts and composition are used effectively.	The design is generally harmonious; some visual elements do not fully align.	The design is inconsistent; the colours and elements have been chosen at random.	The design does not meet the requirements; the visual solutions are haphazard and of poor quality.
Interface functionality (0–25)	All elements work correctly; the site is fully functional; the user experience is of a high standard.	The main functions work; there are minor bugs, but they do not generally hinder use.	A number of functions are not working properly; difficulties are being encountered in use.	Many features do not work; the site is unusable or very difficult to use.
Accuracy and quality of content (0-25)	The content is complete, accurate, well-structured and fully relevant to the topic; there are no linguistic or stylistic errors.	The content is sufficient, but there are some inaccuracies or minor errors.	The content is only partially complete; it contains errors; the structure is weak.	Content is insufficient or incorrect; not relevant to the topic.

Source: Authored by the researcher

Each criterion was assessed on a set scale, and the overall results of the practical tasks were converted to a 100-point system. The final mark was calculated by averaging the results of the theory test and the practical tasks.

A 12-item questionnaire was used to assess students' attitudes towards the use of artificial intelligence tools. The questionnaire had a mixed structure. The first question was presented as a multiple-choice question, whilst the remaining questions were rated on a Likert scale (1 = strongly disagree, 5 = strongly agree). The first question of the questionnaire aimed to determine which artificial intelligence tools the students used at each stage of completing the practical assignment (defining the topic and planning the structure, developing the design, preparing the content, and creating and publishing the website).

The remaining 11 survey questions concerned aspects such as effectiveness (4 questions), ease of use (4 questions) and difficulties encountered when using (3 questions) AI tools. This structure enabled a comprehensive assessment of the students' experience in using artificial intelligence tools.

The data obtained using diagnostic tools were analysed using descriptive statistics and comparative analysis. Student's t-test was used to identify within-group differences. The results were processed in the Python programming environment and presented as histograms and box plots.

Results and their discussion. A comparative analysis was conducted to assess the effectiveness of incorporating artificial intelligence tools into practical lessons. The distribution of pupils' academic performance during the control and experimental phases is shown in Figure 1.

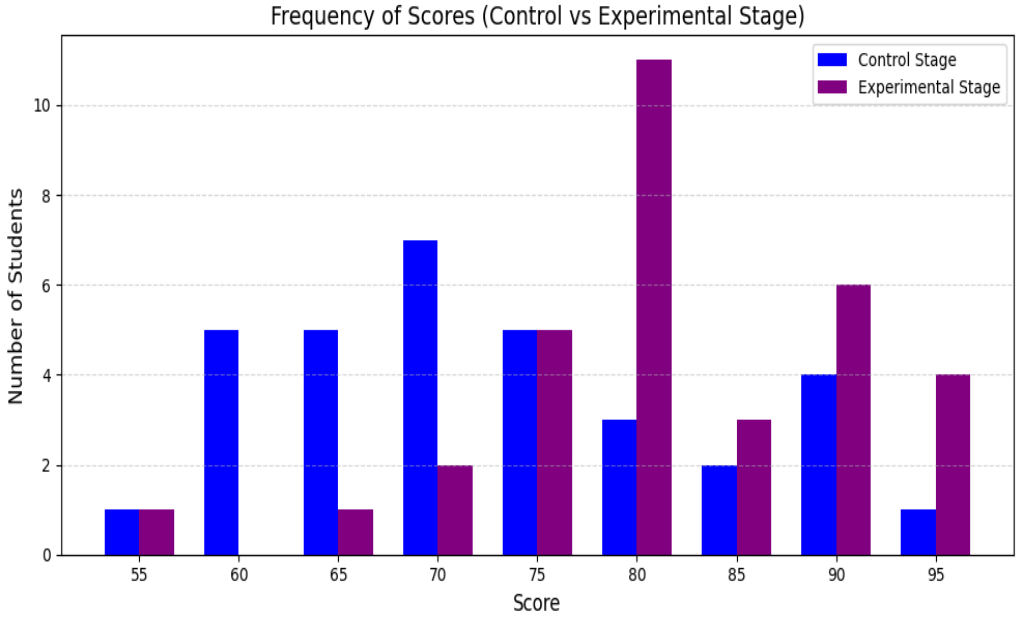

Figure 1. Frequency distribution of scores

Source: Authored by the researcher

In the results of the control stage, it is noted that the main part of the ratings is concentrated in the range of 60-75 points. This suggests that most of the students' academic achievements were moderate. In addition, scores of 65 and 70 are considered as more common indicators, which means that this interval occupies a dominant place in the distribution structure.

The results of the experimental stage show significant changes in the structure of the distribution of grades. Most of the scores are concentrated in the range of 75-90 points, with 80 points highlighted as the most common value. This indicates an increase in student academic performance and an increase in the number of students who received higher scores.

The results of the comparative analysis show that the proportion of high grades increased in the second week compared to the first. For example, the number of students receiving 80, 90, and 95 points increased significantly in the experimental stage. Conversely, the frequency of grades in the lower range (55–65 points) decreased. This indicates an increase in the overall level of learning outcomes and a qualitative improvement in student performance.

Overall, the distribution of grades shows that in the experimental stage, results shifted toward the high-score range. This change indicates an effective organization of the educational process and an improvement in student performance on practical assignments. Furthermore, the concentration of results in the high range indicates increased student engagement and improved learning.

Statistical analysis methods were used to determine the significance of differences between students' academic performance over two weeks of study (Table 2).

Table 2. Comparative descriptive analysis

Indicator	**Mean**	**Median**	**Mode**	**SD**
Control stage	73.03	70	70	10.68
Experimental stage	81.52	80	80	9.14

Source: Authored by the researcher

According to the results of descriptive statistics, the average score in the control stage was 73.03, and in the experimental stage this indicator increased to 81.52. Thus, it was found that the average academic achievement increased by 8.49 points, or about 11.6%.

A paired Student's t-test was used to determine the statistical significance of the differences, and the results showed that the difference between the two stages was statistically significant ($p < 0.05$). These results indicate that the use of artificial intelligence tools contributed to a significant improvement in learning outcomes.

For a more detailed analysis of the distribution of academic achievements and the identification of patterns that characterize the effectiveness of the use of artificial intelligence technologies in practical training, an in-depth visual and statistical analysis was carried out. The Boxplot chart was used as an analytical tool, providing the ability to estimate median values, ranges, and anomalous deviations within the sample (Figure 2). The use of this method made it possible to obtain a holistic view of the data structure, expand the capabilities of descriptive statistics and improve the accuracy of interpretation of the study results.

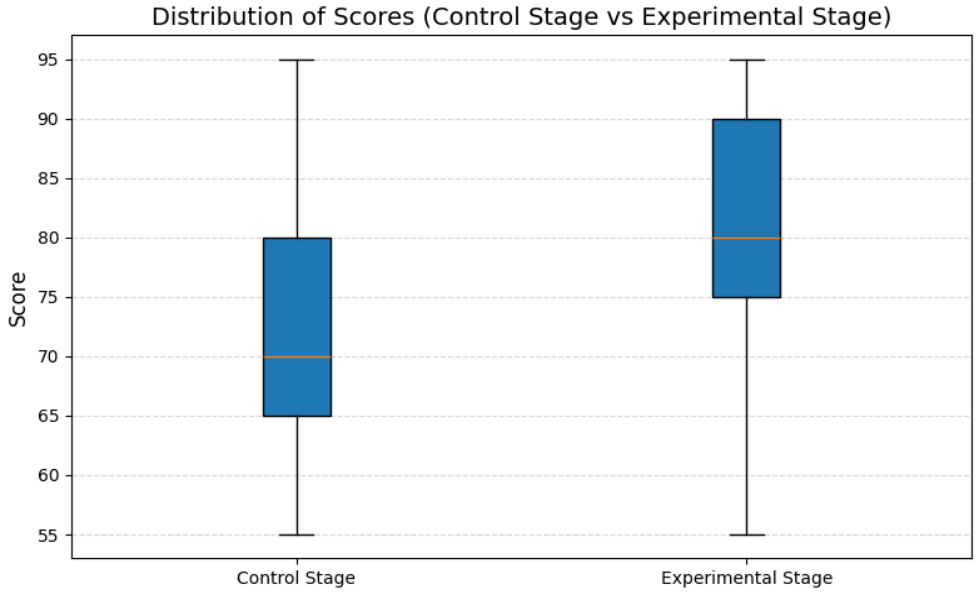

Figure 2. Distribution of Grades (Boxplot)

Source: Authored by the researcher

A comparative analysis of the two stages results shows that in the experimental stage, the central tendency of the scores increased, and the results shifted toward higher scores. The increase in the median score from 70 to 80 points indicates a significant improvement in students' learning. Furthermore, the increase in the bottom quartile score from 65 to 75 points indicates that the majority of students in the group also improved their performance.

Thus, the results of the statistical analysis also empirically confirm that the integration of artificial intelligence technologies into practical classes contributes to the improvement of student academic performance, the quality of knowledge acquisition and the stability of learning outcomes.

The absence of statistically significant outliers and extreme values indicates the consistency of academic achievements and a uniform level of assimilation of the content of practical classes by all students. Based on these data, it can be concluded that the introduction of artificial intelligence tools in practical training has ensured consistency, methodological consistency and sustainable dynamics of mastering educational material.

From a pedagogical and methodological position, the results obtained confirm the high potential for the use of artificial intelligence tools in the process of modernizing practice-oriented learning. There is an increase in the educational activity of students, an increase in the quality of tasks, as well as the formation of a more flexible and adaptive model of educational interaction, which contributes to the development of independence, critical and reflective thinking of students.

Thus, the results of visual and statistical analysis confirm the stability and balance of students' educational achievements, which serves as empirical confirmation of the effectiveness of the methodology for integrating artificial intelligence technologies into the educational process.

The results of the survey showed that the use of artificial intelligence has a significant impact on the organization and effectiveness of practical training. The introduction of artificial intelligence technologies into the educational process has significantly changed the structure of practical classes. In particular, compared to classes conducted without the use of artificial intelligence tools, students' academic activity increased by approximately 35%, and the time spent on practical tasks decreased by an average of 40%. In addition, the time spent on providing feedback was almost halved, and the teacher's workload was reduced by approximately 25%.

The survey found that approximately 90% of students actively use artificial intelligence tools. (Figure 3).

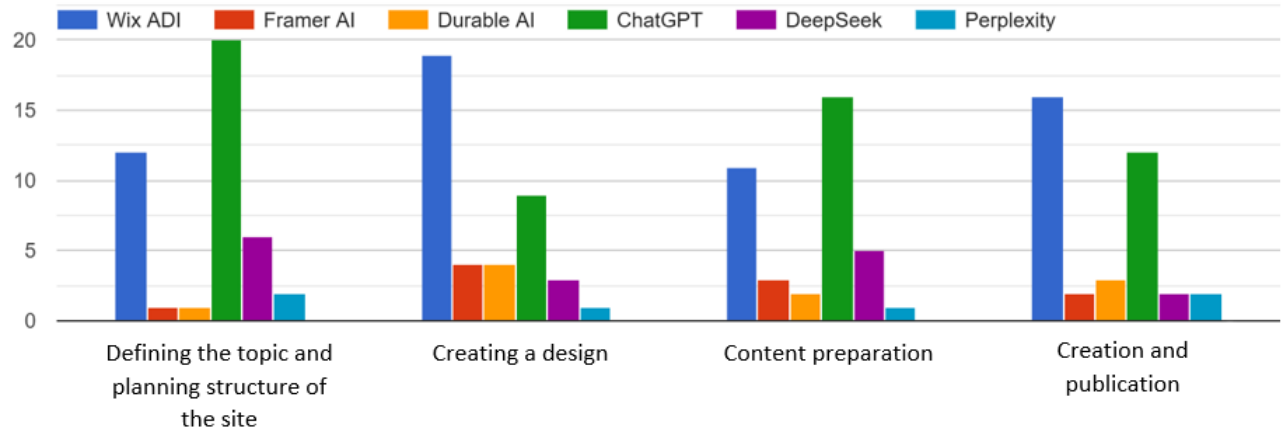

Figure 3. Frequency of use of students' AI tools in practical classes

Source: Authored by the researcher

During the topic-selection phase, the majority of students chose ChatGPT (n = 19; 57.5%), which is in line with expectations for a phase focused on cognitive processes. Wix ADI was used as a source of structural templates (n = 13; 39.3%). DeepSeek (n = 6) is used for initial topic research. A sharp shift is observed during the design phase: Wix ADI takes first place (n = 18; 54.5%), whilst ChatGPT drops to n = 9 (27.2%). This sample indicates functional specialisation: students distinguish between tools by task type — verbal (LLM) and visual-constructive (design) — without any pedagogical instructions. At the content-filling stage, ChatGPT regains the lead (n = 16; 48.4%), whereas at the publication stage, Wix ADI (n = 16; 48.4%) takes first place again thanks to its built-in hosting capabilities. Perplexity remains a secondary tool at all stages (total n = 6; 3.6%).

According to the analysis results, the tools are divided into four categories according to their role in the learning process (Table 3).

Table 3. Classification of AI tools by their function

Groups	AI Tools	Periods	Function
Automation constructors	Wix ADI, Durable AI	Design, Publication	Offline generation of the web frame, structure and visual design of the site without coding
Cognitive Assistants	ChatGPT, DeepSeek	Defining the topic/Structure, Content	Support for content planning, generation, critical analysis and restructuring
Visual Generators	Framer AI	Design	Prototyping of UI solutions while preserving the student's author's design solutions
Information filters	Perplexity AI	Defining the topic /Structure	Accelerated search and primary aggregation of sources as an "input" step of the chain

Source: Authored by the researcher

Automated constructors (Wix ADI, Durable AI) can independently create a fully-fledged web product in a short space of time. This allows teaching time to be devoted to higher-order cognitive activities; however, the student receives the final result without having mastered the intermediate skills, which means that the practical aspects of the task may be lost. The pedagogical solution lies in the introduction of reflective tasks.

Cognitive assistants (ChatGPT, DeepSeek) are transforming the cognitive architecture of the learning process by generating content, suggesting alternative structures and conducting critical analysis. Although the benefit lies in the development of metacognitive skills (planning, reflection, critical thinking), there is a risk that learners may entrust their thought processes entirely to AI.

Visual generators (Framer AI) facilitate the development of interface prototypes, expanding visual solutions whilst preserving the student's creative input. However, they require a basic understanding of design.

Information filters (Perplexity AI) speed up the search for and initial processing of information, helping to establish a factual foundation. They are used at the initial stage, before cognitive assistants are deployed, to verify the accuracy of information.

Thus, the selection of artificial intelligence tools was based not on their technical specifications, but on their primary pedagogical function within the context of the learning objective. This approach enables these tools to be used in a targeted and effective manner at every stage of the practical sessions.

The survey results for the remaining 11 questions indicate that students have a highly positive attitude towards the introduction of artificial intelligence tools into the educational process (Figure 4).

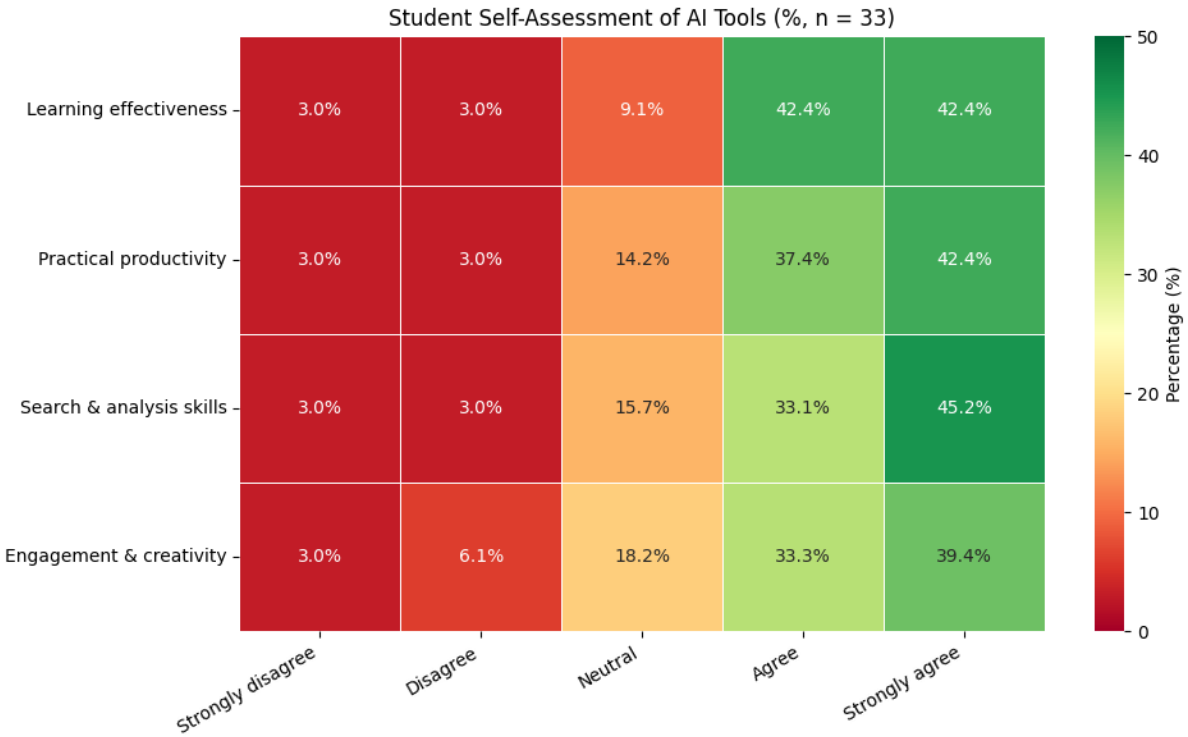

Figure 4. Results of quantitative assessment of students' level of agreement

Source: Authored by the researcher

Thus, about 85% of respondents noted that the use of artificial intelligence tools contributes to increasing the efficiency of educational activities and facilitates the performance of practical tasks. These results prove that students were able to effectively use AI tools for various purposes. 80% of students noted that AI platforms increased the productivity of practical classes.

In addition, 78% of the survey participants indicated the development of their abilities for independent search, selection and analytical processing of information, which reflects the formation of elements of research and critical-analytical competence.

No less indicative is the fact that 72% of students characterized practical classes conducted using AI as more dynamic, interesting and creative. These data indicate an increase in the motivational component of educational activities, an increase in student involvement and an increase in the emotional attractiveness of the educational process.

Taken together, the results obtained confirm that the integration of artificial intelligence tools contributes to the formation of an active position of the student, the development of digital autonomy and the transformation of traditional approaches to the organization of practical training.

An analysis of the study's results allows us to develop a pedagogical model that effectively utilizes artificial intelligence tools in practical classes during the training of future computer science teachers (Figure 5). The proposed model aims to ensure students' professional and digital competencies, taking into account the interrelationships between the key structural elements of the educational process.

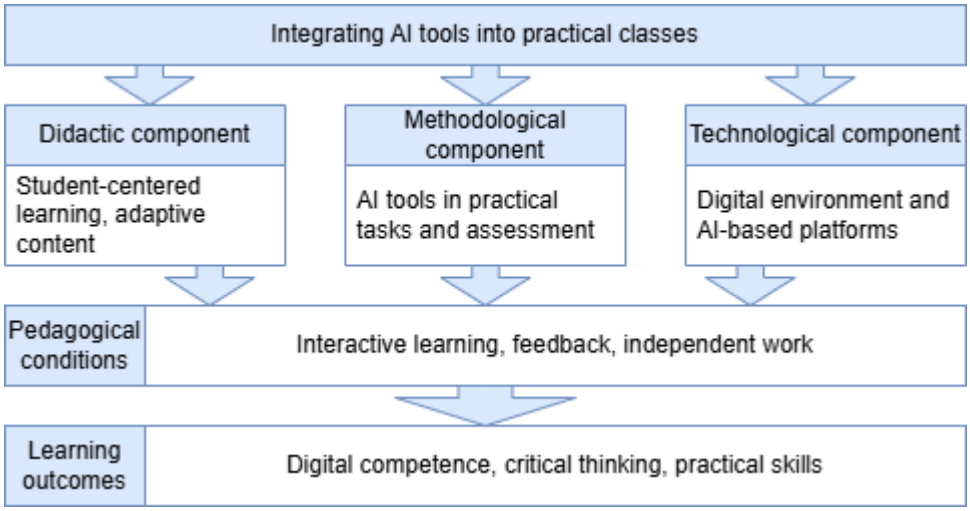

Figure 5. Pedagogical model of integrating AI tools into practical classes

Source: Authored by the researcher

The model's primary goal is to develop the professional, digital, and analytical competencies of future computer science teachers through the use of artificial intelligence tools in practical classes. This goal is driven by the need to organize the educational process in the context of digital transformation and improve students' readiness for practical work.

The didactic component is concerned with organizing learning content and managing students' cognitive activity. The use of artificial intelligence tools enables the individualization of learning materials and the creation of individual learning paths for students. AI tools enable the adaptation of educational content to students' level of preparation, cognitive characteristics, and learning needs. This helps increase motivation for learning, develop metacognitive skills, and develop the ability to independently assimilate knowledge.

The methodological component determines the form of organization, methods of practical classes and ways of pedagogical interaction. The use of artificial intelligence tools, such as ChatGPT, Copilot, DeepSeek and Quizizz, provides automation of assessment processes and the generation of feedback in real time. The use of such solutions allows to increase the objectivity of assessment procedures, minimize the teacher's time spent and increase the accuracy of the analysis of students' educational achievements. methodological flexibility of pedagogical activity and the interaction of the subjects of the educational process is optimized.

The technological component characterizes the digital infrastructure for organizing practical classes. The integration of artificial intelligence tools expands the digital space of practical training through the introduction of generative technologies, visual design tools and web content creation.

Using ChatGPT, Wix ADI, Framer AI, Durable AI, DeepSeek, and Perplexity AI in website development helps develop students' applied and design competencies, as well as foster creative and critical thinking, which is especially important in the context of training future computer science teachers.

The effective implementation of the proposed model requires the provision of the following pedagogical conditions:

- systematic implementation of artificial intelligence tools in practical exercises;
- organization of interactive learning activities;
- support for students' independent learning activities;
- providing prompt feedback between the teacher and the student;
- formation of a digital educational environment.

A comprehensive comparative analysis conducted to substantiate the scientific basis of the proposed research model clearly demonstrates its alignment with international research and its methodological distinctiveness. For example, while Li et al. examine artificial intelligence (AI) primarily in terms of knowledge analytics and teaching automation, Miron et al. prioritizes the psychological acceptance of technology and digital infrastructure issues. In this context, our proposed model goes beyond simple tool-level integration, offering a comprehensive approach that integrates pedagogical content, the digital environment, and teaching methods [12, p. 4-5; 13, p. 30-31]. Maintaining the strong pedagogical foundations of professional development in the Rincon-Gallardo model, our study examines AI tools (ChatGPT, Wix ADI, Perplexity, etc.) and aims to enhance the competence of future teachers through the systematic integration of AI tools (ChatGPT, Wix ADI, Perplexity, etc.) into practical lessons [14, p. 172-173].

Substantiating the scientific significance of the research model from an industrial and technical perspective further deepens its interdisciplinary nature. While Jackson et al.'s study examines generative artificial intelligence (GenAI) as a tool for decision-making and strategic planning in complex systems such as supply chains, with a focus on operational efficiency, our model adapts this approach to the educational environment [15, p. 6123-6124]. Here, AI serves not simply as an information resource, but as a key component in managing and optimizing the learning process. Furthermore, Blagodelsky's analysis of AI use in front-end development directly correlates with the technical component of our model (web content creation, design) [16, p. 1071-1072]. Because Blagodelsky emphasizes the importance of combining theoretical knowledge with practical programming, our study examines AI tools as a didactic foundation for developing students' technical skills.

Thus, while the international pedagogical and technical research reviewed confirms the effectiveness of AI in specific sectors, the proposed comprehensive model integrates these technological capabilities into a unified system aimed at developing the professional competence of future computer science teachers.

It should be emphasized that the use of AI technologies does not lead to the displacement of traditional forms of education, but, on the contrary, contributes to their enrichment and improvement. AI tools play the role of support tools that increase the effectiveness of pedagogical activities, as well as create conditions for the organization of an interactive, self-developing educational environment.

The transformation of the role of the teacher in the context of the use of AI is manifested in the transition from the function of knowledge translation to the role of a mentor, consultant and moderator of the educational process. This transition reflects the key principles of the modern student-centered learning paradigm, which involves the active involvement of the student in the processes of analysis, reflection and self-assessment.

Thus, the development of digital and analytical competencies of students through artificial intelligence systems contributes not only to increasing the level of their professional training, but also to strengthening the competitiveness of future teachers in the labor market. In the future, this direction can become one of the methodological foundations for modernizing the training of specialists in the

field of pedagogical informatics, ensuring their readiness to function in the context of the digital transformation of education.

Conclusion. Comprehensive answers were provided to all three research questions posed during the study: the pedagogical and technological prerequisites for the implementation of artificial intelligence tools in practical lessons were identified, and their positive impact on pupils' learning outcomes and their attitude towards the learning process was empirically demonstrated. A pedagogical model for the effective integration of artificial intelligence tools into practical lessons was also proposed.

The integration of artificial intelligence tools into practice-oriented forms of education is considered one of the key areas of innovative evolution in the higher education system. Current research shows that the use of artificial intelligence tools significantly enhances the individualization of the educational process, intensifies students' cognitive activity, and automates a significant portion of educational and practical tasks.

From a pedagogical perspective, the introduction of artificial intelligence tools transforms all structural components of the educational process – didactic, methodological, and technological. At the same time, teachers' activities become more exploratory and creative, and the student's role shifts from that of passive recipients of knowledge to an active, subjective position based on interaction, independence, and reflection.

The inclusion of artificial intelligence tools in the structure of practical classes ensures the activation of independent educational activities of students, contributes to the consolidation of practical skills and the formation of sustainable professional competencies. The educational process in such conditions acquires the properties of adaptability, interactivity and flexibility, which meets the modern requirements of the digital educational environment.

At the same time, the effective use of artificial intelligence technologies in the higher education system requires the solution of a number of important tasks related to compliance with the principles of academic honesty, the protection of personal data and the formation of an ethical culture of all participants in the educational process.

In the long term, the large-scale integration of AI technologies into pedagogical design, adaptive assessment, and digital learning management can become the basis for a profound transformation of higher education. Therefore, artificial intelligence should be considered not just as an auxiliary tool, but as a key element in the formation of a new educational paradigm focused on personalization, research activity and continuous professional development.

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ЖАСАНДЫ ИНТЕЛЛЕКТ ҚҰРАЛДАРЫН ТӘЖІРИБЕЛІК САБАҚТАРҒА КІРІКТІРУДІҢ ПЕДАГОГИКАЛЫҚ ЖӘНЕ ТЕХНОЛОГИЯЛЫҚ НЕГІЗДЕРІ

Аңдатпа

Қазіргі таңда білім беру жүйесінің стратегиялық дамуының басты бағыты – цифрлық технологиялар мен жасанды интеллект (ЖИ) құралдарын оқу процесіне тиімді кіріктіру болып табылады. Бұл бағыт білім беру сапасын арттырудың маңызды тетігіне айналып отыр, әсіресе жоғары оқу орындарында тәжірибелік сабақтардың мазмұнын жетілдіру мен оқыту әдістемесін жаңғырту тұрғысынан ерекше мәнге ие. ЖИ құралдары оқытушы мен студент арасындағы өзара әрекеттесуді жандандырып қана қоймай, оқу материалын дараландыруға, тапсырмаларды автоматтандыруға және жедел әрі сапалы кері байланыс орнатуға мүмкіндік береді. Мұндай тәсіл student-centered learning тұжырымдамасымен тығыз байланысты, себебі ол білім алушының оқу белсенділігін күшейтуге, өзіндік білім алу қабілеттерін жетілдіруге бағытталған.

Мақалада жоғары оқу орындарындағы тәжірибелік сабақтарға ЖИ құралдарын кіріктірудің педагогикалық және әдістемелік негіздері жан-жақты талданады. Зерттеу барысында ChatGPT, Wix ADI, Framer AI, Durable AI және басқа да заманауи ЖИ платформалары тәжірибелік тапсырмалардың мазмұнын байытуда және оқу процесін жандандыруда қолданылды. Ұсынылған әдістемелік модель үш негізгі кезеңнен тұрады: дайындық кезеңі (құралдарды іріктеу және тапсырмаларды жобалау), оқыту кезеңі (интерактивті тәжірибелік әрекет), бағалау және талдау кезеңі (нәтижелерді автоматтандырылған түрде өңдеу және кері байланыс).

Эксперименттік зерттеу нәтижелері ЖИ құралдарын қолдану тәжірибелік сабақтардың тиімділігін едәуір арттыратынын көрсетті. Студенттердің пәнге деген қызығушылығы мен танымдық белсенділігі өсті, ал топтық және жобалық жұмысқа қатысу деңгейі жоғарылады. Сонымен қатар, оқу процесі икемді және бейімделгіш сипатқа ие болды, бұл білім сапасына оң әсерін тигізді. Мақалада ЖИ технологияларын тәжірибелік сабақтарға енгізудің педагогикалық мүмкіндіктері мен әдістемелік шарттары кешенді түрғыда қарастырылып, оқыту сапасын арттырудың тиімді жолдары анықталған.

Ұсыныстар қатарында оқытушылардың цифрлық құзыреттілігін арттыру, оқу-әдістемелік кешендерге ЖИ құралдарын енгізу, студенттердің жобалық және зерттеу жұмыстарында ЖИ технологияларын кеңінен пайдалану жолдары нақты көрсетілген.

Түйінді сөздер: жасанды интеллект, тәжірибелік сабақ, цифрлық технологиялар, ЖИ құралдары, ChatGPT, әдістемелік модель, жоғары білім беру.

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ПЕДАГОГИЧЕСКИЕ И ТЕХНОЛОГИЧЕСКИЕ ОСНОВЫ ИНТЕГРАЦИИ СРЕДСТВ ИСКУССТВЕННОГО ИНТЕЛЛЕКТА В ПРАКТИЧЕСКИЕ ЗАНЯТИЯ

Аннотация

В современных условиях стратегическое развитие системы образования определяется приоритетной ориентацией на эффективную интеграцию цифровых технологий и инструментов искусственного интеллекта (ИИ) в образовательный процесс. Интеграция ИИ-технологий позволяет не только модернизировать содержание практических занятий и методы преподавания, но и обеспечить индивидуализацию обучения, оперативную обратную связь и автоматизацию ряда педагогических функций. Подобные изменения напрямую связаны с реализацией принципов личностно-ориентированного подхода, направленного на развитие самостоятельности и познавательной активности студентов.

В статье представлен комплексный анализ педагогических и методических основ применения инструментов искусственного интеллекта в образовательной практике вузов. В ходе исследования были апробированы такие платформы, как ChatGPT, Wix ADI, Framer AI, Durable AI и другие, использование которых способствовало обогащению содержания практических заданий и повышению мотивации обучающихся.

Разработанная модель интеграции ИИ включает три последовательных этапа: подготовительный (определение целей и подбор цифровых средств), обучающий (организация интерактивной деятельности студентов) и оценочно-аналитический (автоматизированная обработка результатов и предоставление индивидуализированной обратной связи).

Результаты педагогического эксперимента подтвердили, что систематическое использование ИИ-инструментов способствует росту интереса к учебной дисциплине, активизации познавательной деятельности и развитию навыков совместной работы. Применение технологий искусственного интеллекта делает образовательный процесс более гибким, адаптивным и ориентированным на личные образовательные траектории студентов.

В заключение предложены направления дальнейшего совершенствования образовательной практики, включающие повышение цифровой компетентности преподавателей, внедрение ИИ-инструментов в учебно-методические комплексы и расширение их использования в исследовательской и проектной деятельности обучающихся.

Ключевые слова: искусственный интеллект, практические занятия, цифровые технологии, инструменты ИИ, ChatGPT, методическая модель, высшее образование.

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