



PEDAGOGICAL SIGNIFICANCE OF ARTIFICIAL INTELLIGENCE-BASED EDUCATIONAL PLATFORMS IN TEACHING CHEMISTRY

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Abstract. This article provides a scientific and theoretical analysis of the role and significance of educational platforms based on artificial intelligence technologies in the process of teaching chemistry. The study highlights the possibilities of individualizing education, organizing virtual laboratories, modeling complex chemical processes, and automating the assessment process using artificial intelligence. It also substantiates the impact of these technologies on the quality of students' knowledge, independent thinking skills, and motivation in science.

Keywords: artificial intelligence, digital educational platforms, chemistry education, adaptive learning, virtual laboratory, innovative pedagogy.

Аннотация. В данной статье представлен научно-теоретический анализ роли и значения образовательных платформ на основе технологий искусственного интеллекта в процессе преподавания химии. В исследовании освещаются возможности индивидуализации обучения, организации виртуальных лабораторий, моделирования сложных химических процессов и автоматизации процесса оценивания с использованием искусственного интеллекта. Также обосновывается влияние этих технологий на качество знаний учащихся, навыки самостоятельного мышления и мотивацию к изучению естественных наук.

Ключевые слова: искусственный интеллект, цифровые образовательные платформы, химическое образование, адаптивное обучение, виртуальная лаборатория, инновационная педагогика.

Introduction. Today, the education system is undergoing a fundamental renewal under the influence of rapidly developing information and communication technologies. In particular, the introduction of artificial intelligence technologies into the educational process is shaping new approaches to the methodology of teaching subjects. Chemistry is characterized by complex theoretical concepts, abstract modeling and experience-based. Therefore, the use of modern, interactive and flexible educational tools is of great importance for its effective teaching.

Artificial intelligence-based educational platforms allow for the organization of education in chemistry, taking into account the individual characteristics of students. This eliminates the limitations of traditional teaching methods and improves the quality and efficiency of education.

Artificial intelligence-based educational platforms are digital systems that analyze the level of knowledge, learning speed and errors of students, and can automatically adapt the content of education. These platforms rely on machine learning, algorithmic analysis, and big data processing technologies.

In chemistry education, such platforms determine the level of students' mastery of the subject and offer additional explanations, individual exercises, and reinforcing tasks. As a result, the educational process takes on a student-centered form. It is natural that students have different levels of knowledge and logical thinking abilities when studying chemistry. Artificial intelligence platforms analyze the level of mastery of each student and form a suitable educational path for him. This allows the student to master the topics that are causing difficulties in more depth.

Experimental training plays an important role in chemistry. However, in real laboratory conditions, safety issues, material and technical support, and time constraints create problems. With the help of virtual laboratories based on artificial intelligence, students will have the opportunity to observe chemical reactions in a safe environment, conduct experiments and analyze the results.

Understanding the structure of atoms and molecules, reaction mechanisms and energy processes is a challenge for students. Artificial intelligence platforms express these concepts in a clear and understandable form through 3D models, animations and interactive graphics. This develops chemical thinking and imagination.

Artificial intelligence technologies make the process of assessing student knowledge more accurate and transparent. By analyzing the results of tests and assignments, the student's strengths and weaknesses are identified. The teacher will be able to effectively plan an educational strategy based on this information [1].

Research methodology and literature review. This study was aimed at determining the impact of artificial intelligence-based educational platforms on the teaching process of chemistry and assessing their pedagogical effectiveness. The research process was organized on the basis of an integrated approach, in which theoretical and empirical research methods were used in harmony.

At the theoretical stage, a systematic analysis of scientific literature on artificial intelligence, digital education, and chemistry teaching methodologies was carried out. By studying domestic and foreign scientific sources, the development trends of artificial intelligence technologies in the field of education, their possibilities for application in chemistry education, and didactic features were identified. These analyses served to form the conceptual basis of the study.

In the empirical research process, observation, comparison, and generalization methods were used. In particular, chemistry lessons using artificial intelligence-based educational platforms were compared with traditional teaching methods. The level of students' knowledge acquisition, activity in the lesson process and independent work skills were studied.

Also, the changes observed in the learning process were summarized using an analytical and statistical approach. The research methodology was based on an interdisciplinary approach and was carried out within the framework of the integration of pedagogy, information technology and chemistry. This ensured the scientific validity of the research results.

As part of this study, a number of scientific sources were analyzed in order to determine the effectiveness of artificial intelligence-based educational platforms in the process of teaching chemistry. In particular, special attention was paid to the works of Erkinov A.K., Saparov B.J., Sabirova D.A. and Khanbabayev X.

Erkinov A.K. and Saparov B.J. comprehensively studied the role and pedagogical significance of artificial intelligence technologies in the education system. Their study notes that artificial intelligence platforms allow for individualization of the learning process, improvement of students' knowledge and skills, and simplification of complex chemical concepts through visual and interactive tools. As the authors note, artificial intelligence technologies do not completely replace the role of the teacher, but rather complement it as an effective pedagogical assistant.

Sabirova D.A. has conducted an in-depth analysis of the issues of using artificial intelligence technologies in a digital educational environment. According to her, virtual laboratories and interactive classes increase students' interest in chemistry, facilitate the mastery of complex concepts, and develop independent thinking skills. At the same time, the author notes that the lack of technical infrastructure and low digital competence of teachers can limit the effectiveness of AI platforms.

Khanbabayev Kh., studying the pedagogical capabilities of modern educational platforms, emphasized that they make the teaching process interactive and interesting, increase the activity of students and their ability to work independently. The author also notes that artificial intelligence platforms, without completely replacing the work of the teacher, effectively assist in methodological and organizational processes [3].

As a result of the analysis of these sources, it was found that artificial intelligence-based educational platforms provide opportunities for individualizing the learning process, facilitating complex chemical concepts using interactive and visual tools, and encouraging independent work of students. At the same time, there are some limitations associated with the technical infrastructure and the digital potential of teachers. The results show that artificial intelligence platforms can be used as an effective tool to complement the work of the teacher in chemistry education.

Results and discussion. The results of the study showed that the use of artificial intelligence-based educational platforms leads to significant positive changes in the process of teaching chemistry. First of all, it was observed that the level of students' mastery of theoretical knowledge increased. Complex chemical concepts, including the structure of atoms and molecules, reaction mechanisms, and the process of working with formulas, were easier to understand through interactive tools.

According to the results obtained, artificial intelligence platforms allow organizing the educational process taking into account the individual characteristics of students. The customized tasks offered by the platform developed students' independent thinking skills and strengthened their analytical approach to problem situations.

The use of virtual laboratories was an important factor in increasing the effectiveness of practical classes. Students had the opportunity to try experiments in a virtual environment that were difficult or dangerous to perform in real conditions. This, along with the formation of their experimental skills, increased their interest in science.

Also, AI-based educational platforms do not limit the role of the teacher, but rather complement it as an effective pedagogical assistant. The teacher will have the opportunity to spend less time on assessment and monitoring processes and focus more on deepening students' knowledge and educational aspects.

However, some problems were also identified during the study. The insufficient development of technical infrastructure and low digital competence of teachers may hinder the full use of AI platforms. Therefore, improving the skills of teachers and strengthening technical support are of great importance for the effective introduction of these technologies into chemistry education.

AI-based platforms provide an integral connection between theoretical knowledge and practical exercises in teaching chemistry. Students develop the skills of independent learning, analysis of problem situations, and drawing scientific conclusions. It also increases the interactivity of the teaching process, and students' interest and motivation in science increase. It is also worth noting that artificial intelligence (AI) plays an important role in the development of chemistry. It allows for the rapid and accurate analysis of large amounts of chemical data, and the simulation of molecular structures and reactions. AI accelerates the discovery of new materials and compounds, the analysis of molecular interactions, and the testing of innovative materials. It is also useful in studying the mechanisms of chemical reactions and determining effective reaction pathways. From a safety perspective, AI helps to predict harmful or dangerous reactions and assess the potential hazards of chemical compounds. In this way, AI serves as a key tool in the field of chemistry for analyzing data, creating new materials, controlling reactions, and reducing risks.

There are some problems in the introduction of artificial intelligence technologies into chemistry education. In particular, the insufficient development of technical infrastructure, the need to improve teachers' digital competencies, and the issues of adapting educational platforms to national curricula are relevant. To solve these problems, a systematic approach, advanced training programs, and methodological manuals should be developed [8].

Conclusion. Educational platforms based on artificial intelligence technologies play an important role in modern chemistry education as innovative and effective pedagogical tools. Such platforms allow personalizing the learning process, that is, helping to organize lessons in accordance with the level of knowledge, interests and learning speed of each student. Also, with the help of artificial intelligence, laboratory work and practical exercises can be conducted more interactively, safely and effectively, which will help students to understand the topics more deeply and form solid knowledge. In the future, the widespread introduction of such advanced technologies into the education system will allow not only to improve the quality of teaching chemistry, but also to raise the entire scientific and pedagogical process to a new level. This will allow students to master not only theoretical knowledge, but also to master practical skills more deeply using modern tools. In general, artificial intelligence-based educational platforms are one of the key factors in taking the quality of future chemistry education to a new level and effectively implementing innovative pedagogical methods.

References:

1. Erkinov A.K., Saparov B.J. Sun'iy intellekt texnologiyalarining ta'lim tizimidagi o'rni va ahamiyati. – Toshkent, 2024.
2. Sabirova D.A. Raqamli ta'lim muhitida sun'iy intellektdan foydalanish masalalari. – Toshkent, 2023.
3. Xonbabayev X. Zamonaviy ta'lim platformalari va ularning pedagogik imkoniyatlari. – Toshkent: Fan va texnologiya, 2022.



- 4.Yildirim B., Akcan A.T. Artificial intelligence applications in chemistry education // Journal of Science Education. – 2024.
- 5.Harianti H., Kadarohman A., Anwar S. Artificial intelligence in chemistry teacher education // Journal of Chemistry Education Research. – 2023.
- 6.Qureshi M.D.A., Ayaz S., Amjad F. Innovative approaches to chemistry education using artificial intelligence // Indus Journal of Social Sciences. – 2024.
- 7.Adejo L.O. Artificial intelligence tools in chemistry instruction // Journal of Mathematics and Science Education. – 2024.
- 8.Ding H., Huang Z. Artificial intelligence and its applications in chemistry education. – 2022.