UDC 378.6.091.3:004.89]-047.37
https://doi.org/10.31612/2616-4868.4.2025.11

RESEARCH OF READINESS FOR THE APPLICATION OF ARTIFICIAL INTELLIGENCE IN MEDICAL EDUCATION

Inna I. Kucherenko, Pavlo V. Mykytenko, Tetiana S. Gruzieva, Anton H. Chebotarenko, Dmytro V. Zolotov, Kateryna O. Hololobova

Bogomolets National Medical University, Kyiv, Ukraine

Abstract

Introduction. Integration into the modern European educational environment brings a series of changes and modernization in approaches to the educational process, professional activities, and the need for digital solutions in everyday life. At the same time, the application and impact of artificial intelligence (AI) in the educational, scientific, and healthcare remain controversial.
Aim. To highlight the results of the analysis of readiness and experience in the application of artificial intelligence in medical education in Ukraine.
Materials and methods. To accomplish the tasks set, the following theoretical and empirical research methods were used: bibliosemantic method, system analysis method, conversations and interviews with participants in the educational process, analysis of readiness and experience in the application of artificial intelligence in medical education in Ukraine, surveying (464 respondents participated in the survey: 439 higher education students and 25 students of professional pre-higher education from Bogomolets National Medical University).
Results. We conducted a questionnaire on the use of AI by medical education students. The results of the survey showed widespread use of AI, and the respondents was indicated by the positive effect of its use. We also summarized the functions and capabilities of AI that respondents would like to have in educational applications and grouped them into five categories. We conducted a thorough analysis of the Digital Competency Frameworks to determine readiness for AI applications in various industries, including the healthcare.
Conclusions. The analysis key Frameworks shows that AI is an important tool that can be applied in various fields of activity and also create a foundation for integrating AI into education and healthcare. AI is a crucial element of Ukraine's digital transformation and has significant potential for application in healthcare. The development of AI requires a comprehensive approach, including regulation, education, and professional training.

Keywords: **digital competence, artificial intelligence (AI), digital competence framework, medical education**

INTRODUCTION

Integration into the modern European educational environment brings a series of changes and modernization in approaches to the educational process, professional activities, and the need for digital solutions in everyday life. When implementing and adapting European legislative documents and requirements, it is important to understand the necessity of such implementation and its positive outcomes for society. At the same time, the application and impact of artificial intelligence (AI) in the educational, scientific, and medical fields remain controversial. AI regulation in Ukraine is a matter of time, and active legislation is already being developed to support AI development while ensuring the protection of human rights and ethical principles. A significant milestone in regulating these issues was the Resolution of the Cabinet of Ministers of Ukraine «On Approving the Action Plan for the Implementation of the Artificial Intelligence Development Concept in Ukraine for 2021-2024» [1].

In 2023, the Ministry of Digital Transformation of Ukraine developed and presented the Roadmap [2], which outlines the key directions for the development and implementation of AI in various fields. These directions have been supported after the publication of the White Paper [3] and the increased regulation of AI in Ukraine. Additionally, AI holds a key place in three resources:

the Framework for Digital Competence of Ukrainian Citizens [4]; the Conceptual and Referential Framework for the Digital Competence of Pedagogical and Scientific-Pedagogical Workers [5]; the Framework for the Digital Competence of Healthcare Workers [6].

AIM

The aim of the article is to highlight the results of the analysis of readiness and experience in the application of artificial intelligence in medical education in Ukraine.

MATERIALS AND METHODS

To accomplish the tasks set, the following theoretical and empirical research methods were used: bibliosemantic method, system analysis method, conversations and interviews with participants in the educational process, analysis of readiness and experience in the application of artificial intelligence in medical education in Ukraine, surveying (464 respondents participated in the survey: 439 higher education students and 25 students of professional pre-higher education from Bogomolets National Medical University).

RESULTS

In November 2024 we conducted a study on the use of AI by medical education students. The responses were distributed by study form as follows: 86.4% full-time, 9.7% part-time, and 3.9% evening study. Additionally, 5% of respondents represented professional pre-higher education – the first (bachelor's) level of higher education, 73.5% – second (master's) level of higher education, and 5% were from the third (educational-scientific) level of higher education. We obtained the following distribution by specialties: «Dentistry» – 9.7%, «Medicine» – 38.6%, «Pharmacy, Industrial Pharmacy» – 18.3%, «Pediatrics» – 28.7%, «Medical Diagnostics and Treatment Technologies» – 1.3%, «Public Health» – 0.9%, and others.

On the question of evaluating their own competence in the use of AI, 79.5% of respondents considered themselves competent in this area, while 20.5% did not. Regarding the use of AI to obtain additional information in the educational process, 73.7% used AI (ChatGPT, Gemini, etc.), 20.3% did not, and 6% were unsure.

Regarding the use of AI-based applications for self-learning and exam preparation, 51.5% used such tools, 36.6% did not, and 11.9% were unsure.

Among the most useful services during their studies, respondents mentioned ChatGPT (chatbot from OpenAI) and Gemini (AI assistant from Google). Regarding the impact of AI on the educational process, 49.8% of respondents believed that AI increased the effectiveness of learning, and 60.3% noted that AI-based applications helped them understand the material better. Responses to questions about attitudes toward AI in the educational process are presented in Fig. 1.

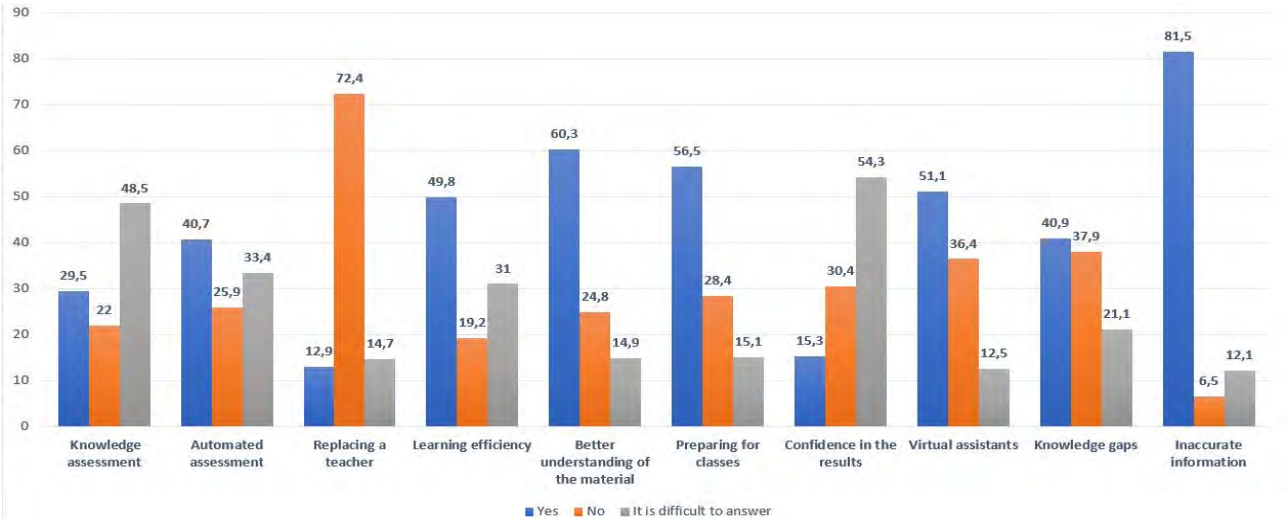

Figure 1. Attitudes towards the use of AI in the educational process of the Bogomolets National Medical University.

To the question «How often do you use AI technologies during your studies?», the respondents provided the following answers: 5% – constantly, 15.1% – often, 43.1% – occasionally, 20.7% – rarely, and 15.9% indicated that they do not use them. 57.1% of respondents noted the convenience of using AI tools in the learning process. The responses regarding the use of AI in scientific work and the educational process are presented in Fig. 2.

We also summarized the functions and capabilities of AI that respondents would like to have in educational applications and grouped them into five categories: information search and access, explanation and assistance in learning, visualization and interactivity, automation and knowledge assessment, additional capabilities (Table 1).

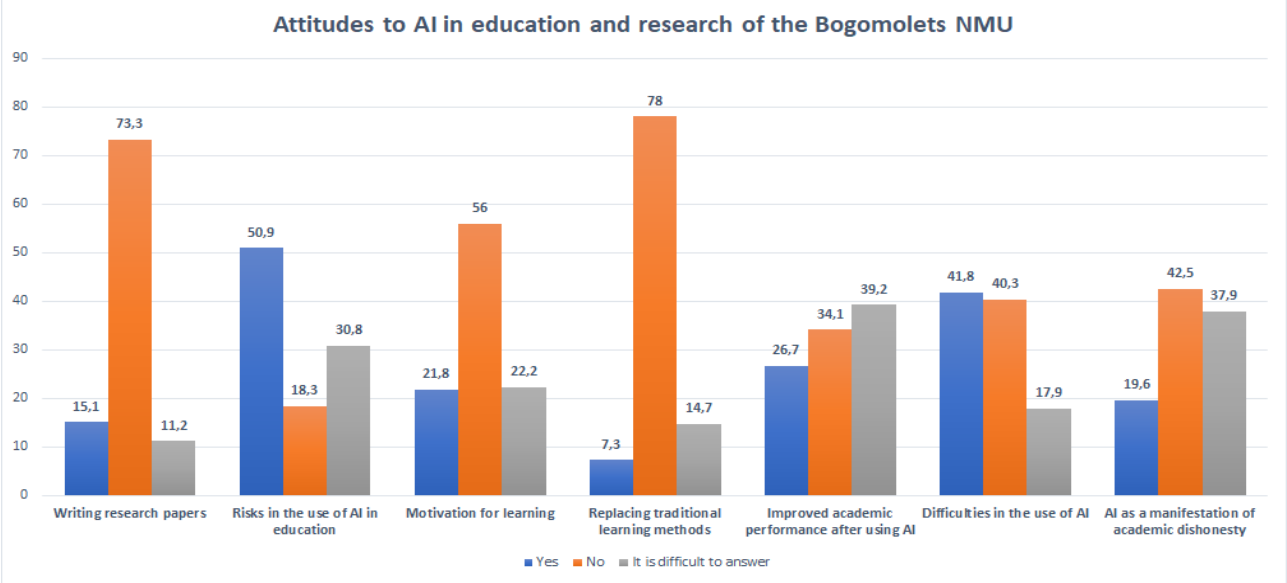

Figure 2. Attitudes to AI in education and research of the Bogomolets National Medical University.

Table 1

Generalized functions and capabilities of AI

Search and Access to information	Explanation and Learning Assistance	Visualization and Interactivity	Automation and Knowledge Evaluation	Additional Opportunities
Fast and accurate search for educational material	Simplified explanation of material	Illustrations, diagrams, tables, 3D models	Automatic test correction	Text-to-speech and audio lectures
Selection and recommendation of reliable sources	Answers to questions with explanations	Visualization of complex processes, chemical structures, medical research	Formation of notes, digests and brief summaries	Generation of presentations based on provided materials
Access to foreign sources and their translation	Correct explanation of mistakes in the text	Graph and visual content generators	Electronic gradebook	Support for students with special educational needs
Extracting key information from articles and books	Interactive explanations through chatbots or voice assistants	Simulations and imitations (e.g., surgical operations)	Analysis of the student's knowledge level and selection of tasks at the appropriate level	Development of critical thinking skills
Search for the latest research and scientific articles	Individualized learning and task adaptation			

DISCUSSION

The Digital Competence Framework for Ukrainian citizens serves as the foundation for developing digital skills among citizens, aiming to provide an understanding of the need to possess basic and advanced digital skills for effective interaction with technologies, including AI. Within the scope of this document, AI is an important tool that enhances the effectiveness of interacting with information and fosters modern approaches to problem-solving in various areas of citizens' lives. In the Digital Competence Framework for Ukrainian citizens, AI is categorized under Area 0: Basic Computer Literacy, C0.A4: Using the Internet and Online Applications. Citizens are expected to assess the pros and cons of using AI-powered search systems (for example, while they can help users find the necessary data, they might compromise privacy and personal data, or prioritize commercial interests): using AI for searching and analyzing information online, effectively using various online services and web applications, including AI-powered ones; selecting the best online solutions, and using AI-driven search engines. The Digital Competence Framework covers a wide range of issues related to modern IT technologies that are crucial both for citizens' professional activities and their everyday life. It includes not only basic knowledge and skills needed to work with digital devices but also more complex aspects, such as digital content creation and analysis, enabling adaptation to rapid technological changes. As noted in [7], it is important to approach the development of competencies in a personalized way, considering the needs of specific individuals rather than just general trends. Defining and selecting the necessary competencies also requires broad discussions among professionals and representatives of different social groups. This approach provides

a more objective understanding of what citizens need for effective work in the digital environment and allows for adapting national training programs to the most important skills. This approach also enables employers, even those whose activities are not directly related to IT, to form requirements for the digital competencies of their employees, optimizing human resources by introducing digital tools into production processes.

In the Conceptual-Referential Framework for Digital Competence of Pedagogical and Scientific-Pedagogical Workers, AI is mentioned in the context of defining the term «digital technologies» as an example of automated analytics systems. This solution can be applied in Area 5: Fostering Competence in Problem Solving in the Digital Environment in Students: C5.A1: Forming and Developing Information Literacy and Media Literacy of Students; C5.A2: Forming and Developing Competence in Creating Digital Content; C5.A3: Teaching Students Effective Communication, Interaction, and Collaboration in the Digital Environment; C5.A4: Forming Digital Culture, Digital Security, and Cyber Hygiene in Students; and C5.A5: Fostering Competence in Problem Solving in the Digital Environment in Students. Educational and scientific-pedagogical workers are key users and implementers of new technologies. Considering the role of teachers in shaping future generations, the introduction of AI in the educational process will be a significant step in modernizing teaching methods and ensuring access to innovative learning resources. This framework defines how teachers should use AI to improve the learning process, develop personalized approaches, and adapt to new technological realities. Competencies related to the use of AI systems are mostly developed by teachers through the system of postgraduate education, which is becoming increasingly important every year. It not only ensures the qualification of teachers but also adapts them to new technological requirements, particularly for the use of AI in the educational process. Recent studies actively explore the theoretical aspects of AI usage in professional activities of teachers and develop methodologies for developing such competencies.

The relevance of preparing teachers to use AI was addressed by L. Kartashova, who emphasizes the need to integrate these technologies into curricula for more effective and adaptive learning. Her works aim to form the theoretical foundations for using AI in the educational environment and develop approaches to its integration into pedagogical practice [7]. A. Melnyk, studying the potential and challenges of using AI in education, highlights the importance of adapting educational systems to new technologies and creating conditions for developing technological competencies in teachers. She addresses the key issues arising from AI integration into educational processes and proposes solutions, particularly by improving teacher qualifications [8].

Special attention should be given to the methodology of using AI systems, such as ChatGPT, particularly in the context of their use in educational institutions, offering recommendations for effectively integrating AI tools into the teaching process. The focus is on the advantages of AI for education, emphasizing its ability to tailor learning to individual students' needs and develop their digital competencies. It also develops a methodology for studying this topic in informatics lessons, which makes it possible, on the one hand, to build essential knowledge about technologies and, on the other hand, to enhance young people's overall digital literacy [9]. According to the results of a nationwide study conducted by the Projector Creative & Tech Institute and the Small Academy of Sciences of Ukraine, with the support of Factum Group Ukraine and information support from the Ministry of Education and Science of Ukraine, 76% of surveyed teachers have used AI systems at least once, including ChatGPT, «To the lesson», and other tools. Teachers applied these technologies for lesson preparation, creating tests for homework, conducting classes, and checking students' knowledge [10].

In the Digital Competence Framework for Healthcare Workers, the use of AI in professional activities is reflected in Area 4: Digital Tools, Devices, and Applications in Healthcare, C4.A2: Using intelligent clinical decision support systems Use of DSS based on the results of intellectual analysis of clinical research (according to professional specialization).

Users should know the methods of formalizing healthcare tasks, their mathematical and computer modeling; know and understand the basic principles and main approaches to implementing AI-based information DSS. In the medical field, AI has the potential to significantly improve diagnosis, treatment, and disease prevention. The Digital Competence Framework for Healthcare Workers envisions the use of AI as a tool for processing large amounts of medical data, increasing diagnostic accuracy and disease prediction, as well as for automating routine tasks, allowing doctors to focus on more complex aspects of treatment. In this context, healthcare professionals should be prepared to use AI technologies to improve the quality of medical services. For the successful digitalization of the healthcare sector in Ukraine, an important aspect is ensuring that workers in this field have the necessary digital skills. This includes the ability to work with electronic medical records, apply telemedicine technologies, and understand the basics of cybersecurity and digital literacy. Given that many healthcare workers have different levels of training in these areas, a clear definition of the digital competence framework is necessary for standardizing their training and ensuring the integration of new technologies into medical practice. The Digital Competence Framework was created to unify the requirements for the level of training of healthcare workers. It will help not only to improve the level of digital literacy but also to create training programs that meet modern industry

requirements. In particular, the framework aims to integrate knowledge and skills in such key components as understanding the principles of e-health, the ability to work with telemedicine platforms, knowledge of the basics of cybersecurity and cyber hygiene, as well as the ability to use digital tools for administrative processes.

For example, the relevance of using AI in medicine is discussed in several works, including [11], which concludes that AI medical assistants can improve safety standards under the supervision of a doctor, and [12], where issues of data, modeling, and confidentiality are explored, which need to be overcome to realize the full potential of multimodal AI in healthcare.

CONCLUSIONS

The analysis of three key resources – the Digital Competence Framework for Ukrainian citizens, the Conceptual-Referential Framework for Digital Competence of Pedagogical and Scientific-Pedagogical Workers, and the Digital Competence Framework for Healthcare Workers – shows that AI is considered an important tool that can be applied in various fields of activity. AI is a crucial element of Ukraine's digital transformation and has significant potential for application in medical areas. The development of AI requires a comprehensive approach, including regulation, education, and professional training. These three frameworks are important stages in the integration of AI into the daily life and professional activities of Ukrainians, defining the necessary digital competencies for the effective use of cutting-edge technologies. They contribute not only to skill development but also to building a foundation for integrating AI into key sectors of the economy and society, including education, healthcare, and the public sector.

The integration into the European educational space involves the implementation of digital technologies, particularly AI, which generates both positive and controversial reactions. A study conducted among medical students at O. O. Bogomolets National Medical University showed that 79.5% of respondents consider themselves competent in using AI, and 73.7% have already applied it in their educational activities. Half of the respondents confirm that AI enhances learning efficiency and helps better understand the material. However, a significant portion of respondents perceives risks in AI, particularly regarding academic integrity and the accuracy of the information obtained. Most do not support replacing teachers with AI but express a positive attitude toward automated assessment of test tasks. The study also found that 81.5% of students have encountered situations where AI provided inaccurate information. Therefore, the need for regulation and adaptation of AI in education remains a relevant issue.

Perspectives for further research. The future of AI in medicine looks promising. Gradually, AI will become an integral part of medical practice, which will save more lives and improve the quality of life of millions of people. Therefore, further directions of our work are the development of recommendations for the use of AI in healthcare, both for students and doctors.

COMPLIANCE WITH ETHICAL REQUIREMENTS

The research was carried out in compliance with the principles of medical ethics and the protection of patients' rights, human dignity and moral and ethical norms, in accordance with the principles of the Helsinki Declaration of Human Rights, the Council of Europe Convention on Human Rights and Biomedicine, the relevant laws of Ukraine.

FUNDING AND CONFLICT OF INTEREST

The authors declare no conflict of interest regarding this article. The study was performed within the framework of a research topic «Ensuring the quality of informatics and physics and mathematics training of future healthcare professionals in the context of classroom and distance learning» (2024-2026, № state registration 0124U000724).

AUTHOR CONTRIBUTIONS

Kucherenko I. I.[A, B, C, D, E, F]
Mykytenko P. V.[A, B, D, E]
Gruzieva T. S.[A, D, E, F]
Chebotarenko A. H.[A, B, D]
Zolotov D. V.[A, B, D]
Hololobova K. O.[A, B, D]

REFERENCES

1. Pro zatverdzhennia planu zakhodiv z realizatsii Kontseptsii rozvytku shtuchnoho intelektu v Ukraini na 2021-2024 rr.: rozporiadzhennia Kabinetu Ministriv Ukrainy vid 12 travnia 2021 r. № 438-r (2021). [On approval of the action plan for the implementation of the Concept of Artificial Intelligence Development in Ukraine for 2021-2024: Order of the Cabinet of Ministers of Ukraine» dated May 12, 2021 № 438-r].

Retrieved from: Retrieved from: https://zakon.rada.gov.ua/laws/show/438-2021-%D1%80#Text
2. Dorozhnia karta z rehuliuvannia ShI v Ukraini (2023). [Roadmap for AI regulation in Ukraine]. Retrieved from: https://thedigital.gov.ua/news/regulyuvannya-shtuchnogo-intelektu-v-ukraini-prezentuemo-dorozhnyu-kartu
3. Bila knyha z rehuliuvannia ShI v Ukraini (2024). [White Paper on AI Regulation in Ukraine]. Retrieved from: https://thedigital.gov.ua/news/regulyuvannya-shtuchnogo-intelektu-v-ukraini-prezentuemo-bilu-knigu
4. Ramka tsyfrovoi kompetentnosti hromadian Ukrainy (2023) [Digital competence framework for citizens of Ukraine]. Retrieved from: https://osvita.diia.gov.ua/uploads/1/7451-ramka_cifrovoi_kompetentnosti.pdf
5. Kontseptualno-referentna Ramka tsyfrovoi kompetentnosti pedahohichnykh y naukovo-pedahohichnykh pratsivnykiv (2021). [Conceptual and Reference Framework for Digital Competence of Pedagogical and Scientific-Pedagogical Workers]. Retrieved from: https://osvita.diia.gov.ua/uploads/0/2900-2629_frame_pedagogical.pdf
6. Kontseptualno-referentna ramka tsyfrovykh kompetentnostei pratsivnykiv sfery okhorony zdorov´ia ta zabezpechennia rozvytku informatsiinoi kultury, tsyfrovoi hramotnosti (tsyfrovoi osvichenosti), kiberbezpeky i kiberhihiieny pratsivnykiv sfery okhorony zdorov´ia [Conceptual and reference framework for digital competencies of healthcare workers and ensuring the development of information culture, digital literacy (digital education), cybersecurity and cyber hygiene of healthcare workers]. Retrieved from: https://bit.ly/ramka-tsyfrovoyi-kompetentnosti-pratsivnyka-okhorony-zdorovya-v1
7. Kartashova, L. A., Boichenko, O. A. (2019). Shtuchnyi intelekt v osviti: aktualnist pidhotovky pedahohiv u tsomu napriami [Artificial intelligence in education: the relevance of training teachers in this area]. XIV International Scientific Conference Modern Achievements in Science and Education. Netanya, Khmelnytskyi, 138-141.
8. Melnyk, A. V. (2023). Zastosuvannia shtuchnoho intelektu v osvitnomu seredovyshchi: potentsial ta vyklyky [Application of artificial intelligence in the educational environment: potential and challenges]. III All-Ukrainian Scientific and Practical Conference Development of Pedagogical Skills of a Future Teacher in the Conditions of Educational Transformations, 250-253.
9. Alieksieieva, S., Aristova, N., Malykhin, O., & Topuzov, O. (2023). Metodolohichni ta dydaktychni zasady kompensatsii osvitnikh vtrat zdobuvachiv povnoi zahalnoi serednoi osvity [Methodological and didactic principles of compensation for educational losses of applicants for complete general secondary education]. Methodological recommendations. Kyiv: Pedagogical opinion, 19-26. https://lib.iitta.gov.ua/id/eprint/737635/1/Osvitni_vtraty-20-26_%D0%A0%D0%BE%D0%B7%D0%B4%D1%96%D0%BB%202.pdf
10. Topuzov, O., & Zasiekina, T. (2022). Zahalna serednia osvita Ukrainy v umovakh voiennoho stanu ta vidbudovy [General secondary education in Ukraine under martial law and reconstruction]. Methodological recommendations. Kyiv: Publishing House «Education», 296 p. doi: 10.32405/978-966-983-360-0-2022-70
11. Lizée, A., Beaucoté, P.-A., Whitbeck, J., Doumeingts, M., Beaugnon, A., & Feldhaus, I. (2024). Conversational medical ai: Ready for practice. arXiv. https://doi.org/10.48550/ARXIV.2411.12808
12. Acosta, J. N., Falcone, G. J., Rajpurkar, P., Topol, E. J. (2022). Multimodal biomedical AI. Nat Med., 28, 1773-1784. doi: 10.1038/s41591-022-01981-2

Резюме

ДОСЛІДЖЕННЯ ГОТОВНОСТІ ДО ЗАСТОСУВАННЯ ШТУЧНОГО ІНТЕЛЕКТУ В МЕДИЧНІЙ ОСВІТІ

Інна І. Кучеренко, Павло В. Микитенко, Тетяна С. Грузєва, Антон Г. Чеботаренко, Дмитро В. Золотов, Катерина О. Гололобова

Національний медичний університет імені О. О. Богомольця, м. Київ, Україна

Вступ. Інтеграція в сучасне європейське освітнє середовище несе низку змін і модернізації підходів освітнього процесу, професійної діяльності та потреби в цифрових рішеннях у повсякденному житті. У той же час застосування та вплив штучного інтелекту (ШІ) в освіті, науці та охороні здоров'я залишаються суперечливими.

Мета. Висвітлення результатів аналізу готовності та досвіду застосування штучного інтелекту в медичній освіті в Україні.

Матеріали та методи. Для виконання поставлених завдань були використані такі теоретичні та емпіричні методи дослідження: бібліосемантичний метод, метод системного аналізу, бесіди та інтерв'ю з учасниками навчального процесу, аналіз готовності та досвіду застосування штучного інтелекту в медичній освіті в Україні, опитування (в опитуванні взяли участь 464 респонденти: 439 студентів вищих навчальних закладів та 25 студентів професійної передвищої освіти НМУ імені О. О. Богомольця).

Результати. Проведено анкетування щодо використання ШІ здобувачами вищої медичної освіти. Результати опитування показали широке використання ШІ, а респонденти відзначили позитивний ефект від його використання. Також узагальнено функції та можливості ШІ, які респонденти хотіли б мати в освітніх програмах, і згруповано їх у п'ять категорій. Здійснено ретельний аналіз Рамок цифрових компетентностей, з метою визначення готовності до застосування ШІ в різних галузях, включаючи охорону здоров'я.

Висновки. Аналіз ключових Рамок цифрових компетентностей показує, що ШІ є важливим інструментом, який можна застосовувати в різних сферах діяльності, а також створює основу для інтеграції ШІ в освіту та охорону здоров'я. ШІ є ключовим елементом цифрової трансформації України та має значний потенціал для застосування в охороні здоров'я. Розвиток штучного інтелекту потребує комплексного підходу, що включає регулювання, освіту та професійну підготовку.

Ключові слова: **цифрова компетентність, штучний інтелект (ШІ), рамка цифрової компетентності, медична освіта**

Received: 10.02.2025
Accepted: 14.04.2025