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TOPICAL ISSUES OF ARTIFICIAL INTELLIGENCE IN THE EDUCATION SYSTEM

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Abstract

The active implementation of artificial intelligence technologies in various spheres of global public life contributes to the actualization of questions about the role of the education system in the technical and technological development of the nation. The goal of the higher education system in the modern conditions of a dynamic and high-tech rhythm is the training of qualified specialists, who are capable to implement their professional activities in conditions of working with highly intelligent technologies. To determine what and how to teach future specialists who will be in demand in the sectors of the economy focused on the use of artificial intelligence, it is necessary to understand the essence and functional role of artificial intelligence, as well as to systematize the idea of using artificial intelligence in education.

The study of the historical dialectic of artificial intelligence technologies shows that artificial intelligence has been improving progressively. In the early stages of its development, it depended on the technical and technological level of development of economic systems. Understanding the essence and the term "artificial intelligence" also occurred gradually. Artificial intelligence was often called ordinary information and information management systems. A modern understanding of the essence of artificial intelligence, based on previous and current achievements in computer science, allows us to highlight the main features that characterize artificial intelligence. These are computer networks, artificial neural networks, databases (BIG DATA), the ability of an intelligent system to self-learn. The inevitability of the introduction of artificial intelligence into the national economy and social life of society leads to the natural need to transform the learning process at universities, the essence of which is the introduction of the use of artificial intelligence into the learning process. The higher education system should include educational technologies that provide future specialists with competencies not only within the framework of professional training, but also skills, abilities and the need for continuous self-development, considering the tools of artificial intelligence and trends in the development of the global educational space.

Keywords: artificial intelligence, higher education system, neural networks, self-learning, intelligent technologies in education.

АКТУАЛЬНЫЕ ВОПРОСЫ ИСПОЛЬЗОВАНИЯ ИСКУССТВЕННОГО ИНТЕЛЛЕКТА В СИСТЕМЕ ОБРАЗОВАНИЯ

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Реферат

Активное внедрение искусственного интеллекта в различных сферах общественной жизни способствует актуализации вопросов о роли системы образования в техническом и технологическом развитии нации. Цель системы высшего образования в современных условиях динамичного и высокотехнологического ритма – подготовка квалифицированных специалистов, способных и имеющих потребность реализовывать профессиональную деятельность в условиях работы с высокоинтеллектуальными технологиями. Для того чтобы определить, чему и как учить будущих специалистов, которые будут востребованными в отраслях экономики, ориентированных на использование искусственного интеллекта, необходимо понять какова сущность и функциональная роль искусственного интеллекта, а также систематизировать представление об использовании искусственного интеллекта в образовательном процессе.

Исследование исторической диалектики технологий искусственного интеллекта показывает, что искусственный интеллект совершенствовался поступательно, на ранних этапах своего развития зависел от технического и технологического уровня развития экономических систем. Понимание сущности и термина «искусственный интеллект» также происходило постепенно. Искусственным интеллектом часто называли обычные информационные и информационно-управляющие системы. Современное понимание сущности искусственного интеллекта, основанное на предыдущих и настоящих достижениях компьютерных наук, позволяет выделить основные признаки, характеризующие искусственный интеллект. Это – компьютерные сети, искусственные нейронные сети, базы данных (BIG DATA), способность интеллектуальной системы самообучаться.

Неизбежность внедрения искусственного интеллекта в национальную экономику и социальную жизнь общества приводит к закономерной необходимости трансформации процесса обучения в университетах, суть которой внедрение использования искусственного интеллекта в процесс обучения. Система высшего образования должна включать образовательные технологии, обеспечивающие будущим специалистам компетенции не только в рамках профессиональной подготовки, но и умения, навыки и потребность постоянного саморазвития с учетом инструментов искусственного интеллекта и тенденций развития мирового образовательного пространства.

Ключевые слова: искусственный интеллект, система высшего образования, нейронные сети, самообучение, интеллектуальные технологии в образовании.

Introduction

The creation of artificial intelligence technologies (hereinafter referred to as AI) is a high-tech breakthrough, comparable in significance to the advent of computers and the Internet. AI, as a developing paradigm, is gradually penetrating many areas of human and social life, becoming an integral part of the optimization of production systems and the improvement of the social life of society. The introduction of AI technologies, as well as the digitalization of processes in general, contributes to the efficient functioning of the economic system, the expansion of investment opportunities, an increase in the level of social security, the efficiency of public administration, etc. In general, digitalization processes are widely supported by the state, therefore, conditions are created at the regulatory level to ensure activities related, among other things, to the use of AI technologies. Programs, concepts, and other strategic documents are being developed to implement the objectives of the digital agenda. In Belarus, issues of digitalization of the economy and society, including the use of AI technologies, are included in the programs for the period 2021–2025: "State Program for Innovative Development of the Republic of Belarus"; State Program "Digital Development of Belarus"; "State Program for the Socio-Economic Development of the Republic of Belarus".

The digital agenda has also affected the education system, and the issues of using AI in the educational process are both a stage in its optimization and a stumbling block in the interaction between teachers and students. According to the UNESCO report [1], in the context of the fourth industrial revolu-

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tion, the economic and social development of a nation is closely linked to its technological progress. In this light, the technical and technological progress of society directly depends on the tasks of higher education. The higher education system makes a significant contribution to innovative and economic development through three missions: teaching and learning, scientific research and interaction with production, organizational management.

The tasks of the educational process are formed based on the social demand of society, in accordance with the needs of the economy and national interests. According to state policy, the training of personnel in higher education institutions involves academic fundamentality and a practice-oriented approach [2]. The result of the universities' activities soon should be the training and provision of such personnel potential that will be able to work in the conditions of a dynamic high-tech rhythm, namely, to use intelligent systems and AI in their professional activities. If not today, then tomorrow in the real sector of the Belarusian economy the need for graduates-specialists capable of solving production problems in interaction with AI will increase. On the one hand, AI encourages the idea of automating teacher tasks [3, 4] on the other hand, it allows to expand human knowledge in learning [5, 6], increase students' motivation, provide them with knowledge and skills that will allow them to work hard [7, p. 19], encourages socialization, namely provides tools for participation in certain social, cultural interactions [7, p. 20], and does not neglect the individualization of the learning process, i.e., to become more autonomous and independent in thinking and acting [7, p. 21]. The higher education system should provide competencies that correspond to the current processes and trends of digitalization of the Belarusian society, as well as consider the main trends in the development of the global educational space, use educational technologies, including the capabilities of AI. Nevertheless, at present the idea of using AI elements in education is not complete and requires proper systematization. Several questions arise, including what the essence and functional role of AI in the training of specialists is; what and how to teach in order to increase the demand for graduates in the context of digitalization and the development of AI in the country's economic systems, etc.

Main part. Problems and prospects of AI in the system of higher education

Part 1. Evolution of understanding and modern perception of AI

People often attribute specialized computer programs to AI that allow to get rid of routine work or, even more, allow to make control decisions. But such an interpretation does not provide an understanding of what functionality AI carries and where the boundary between information technology and artificial intelligence lies. Research of literary sources [8, 9,10, 11, 12, 13] has shown that a generally accepted definition of the concept of "artificial intelligence" has not yet been fully formed. At the same time, the modern perception of the essence of AI is dynamic. The stages of development of understanding of the essence of AI are proposed in the Table.

Table – Characteristics of the stages of development of perception of the essence of AI by year

Stages by year	AI related activities
1935–1960	In 1935, Alan Turing formulated the idea of an abstract computing machine consisting of an infinite memory and a scanner that moves forward and backward through the memory. (Alan Turing, work "Computing Machinery and Intelligence"). The founder of the term AI is John McCarthy – an American scientist who in 1956 with his colleagues (Marvin Minksy, Nathaniel Rochester and Claude Shannon) suggested that "Every aspect of learning or any other characteristic of intelligence can in principle be so precisely described that a machine can be designed to imitate it" [14].
1960–1979	Development of the theoretical and philosophical concept of AI, the main essence of which is self-learning of an intelligent system. Self-learning requires powerful computer support. As a result – the development of computing equipment and computing technologies (storage of large amounts of information, increasing the speed of information processing), the beginning of research by scientists of methods and algorithms of machine learning. Creation of agencies and funds for research in the field of AI, mainly in the USA.
1980–1990	Development of algorithmic tools in the field of AI, expansion of research in the field of machine learning. David Rumelhart and John Hopfield published the results of research on deep learning methods.
1990–early 2000 s	Achieving many goals and objectives in the field of AI, due to the development of significant capacities of software and computing systems. In different countries, research in the field of AI was actively disseminated, experience in using AI was increasing, intelligent systems acquired the ability to self-learn, while collecting, systematizing, analyzing data, making decisions, which was only possible for a person. Such well-known AI applications as Google Search, YouTube, Amazone, Netfix, Google Assistant, Apple Intelligence, ChatGPT, etc. appeared.
2000 s – present	AI "assistants", intelligent technologies and AI elements are becoming an integral part of production and public-social systems. The development and implementation of AI in production is provided for by state and regional strategic programs.

An analysis of the development of events and processes preceding the current understanding of AI allows to identify the enlarged technological periods of the formation of the concept of AI:

The first period (1935–1970) can be called theoretical, when people understood the need and value of accumulated information in electronic form about business, the market, clients, in order to use it more effectively to achieve their goals. The following technical solutions were aimed at achieving this goal: obtaining, processing information, forming and storing data arrays. It is hardly possible to classify the technologies of this period as AI. These were technological operations and processes based on software and computer complexes for the formation of scientific reference information (SRI), which began to be called information systems. According to [15]: "An information system (IS) is a set of data banks, information technologies and software and hardware complexes." Any information system that solves an intellectual problem or uses artificial intelligence methods is classified as intelligent [16].

In the next period (1970 s – 2000 s), with the increasing complexity of NSI arrays (increasing volumes, their heterogeneity), there is a need to automate analytical processes, generate and forecast heterogeneous sets of information, draw conclusions, adapt to emerging failures, and even offer management solutions. All this freed from routine tasks, was useful in production processes, and strengthened the confidence of managers in decision-making. In production and technological systems based on increasingly sophisticated software and computer tools, they sought to move from information systems to information and management systems.

In recent decades, due to several technical innovations, AI has developed rapidly. AI technologies allow an intelligent system to receive and process big data in real time, promptly adjust design decisions, control operations, and draw practical conclusions that contribute to confident decision-making [17].

The study of the history of AI technology development shows that AI has improved and depended on the level of technical support for intelligent systems and their technological development, and, accordingly, different understandings of the essence of AI have arisen. Throughout each period of development of understanding of AI, scientists and researchers have attempted to formulate the definition and essence of AI.

Thus, at the stages of early understanding (before the 90s), in the definitions of AI, researchers emphasize the machine, mechanical, and functional components of artificial intelligence. As a typical example, we will cite the definition given by one of the founders of AI, Marvin Minsky: "The science of how machines do things that would require intelligence as if humans did them" [17]. A similar idea can be seen in the understanding of the essence of AI by other early researchers: John McCarthy, Alan Turing and others.

Starting from the 90 s – 2000 s, the presentation of the essence of AI has acquired a more expanded form. A distinctive feature of the interpretation of AI in recent decades was that AI necessarily works based on the use of neural networks.

Most clearly and accurately, in the authors' opinion, the essence of AI is reflected in the characterization of this term by the English scientist Russell Stewart Jonathan: "Artificial intelligence in the broadest sense is the intelligence demonstrated by machines, in particular computer systems. It is an area of research in computer science that develops and studies methods and software that allow machines to perceive the environment and use learning and intelligence to perform actions that maximize their chances of achieving their goals. Such machines can be called artificial intelligence" [18].

Thus, understanding the essence of AI has its own dialectic of development, which ultimately comes down to the ability of an intelligent system to self-learn and use the acquired knowledge to solve problems, including making decisions, as a person would do. The ability to self-learn can be called one of the main features of AI. Other features of AI are: computer networks (computer and network equipment, software); artificial neural networks (programs or algorithms that use computing systems), databases (BIG DATA).

Currently, AI technologies are being implemented in many sectors of the economy. Many examples of AI use are noted in healthcare, military affairs, financial management systems and banking, online trading, transport and logistics systems, and others. In communication and telecommunications systems, the use of automated online assistants is becoming the norm. The most famous AI systems in the world are: ChatGPT (from the English Generative Pre-trained Transformer), capable of working in a dialog mode, supporting requests in different languages. The system can answer questions, generate texts in various subject areas; Deep Blue is a chess supercomputer; MYCIN is one of the early intelligent systems, was designed for diagnostic tasks in medicine. There are many computer games using AI technologies, the direction is called "gaming artificial intelligence". The largest research centres in the field of artificial intelligence are in the USA, Germany, Japan, Russia, India, China. The Chinese AI industry is developing rapidly. This is confirmed by the fact that the growth rate of the number of patents in this area in the PRC is on average 1.4 times higher than the global average. In China, AI has become one of the key areas of the country's digital economy.

The above facts are a small part of what characterizes the long-term potential of AI, which is actively being introduced into various spheres of public life. It seems that the requirements for AI will only increase over time, since in essence this system must be able to cope with cognitive tasks inherent in humans. At the same time, according to the assessment given in [19]: "Artificial intelligence is algorithms, neural networks of various types, which are laid down by humans. AI will never be smarter than all people, because it is a product of human thinking. AI will not develop until humans develop. And this is the main thing today for understanding the essence of artificial intelligence and the directions in which this all-knowing assistant should be developed." Therefore, the development of AI potential depends on highly qualified specialists, who already today need to be taught to understand AI and work with it, thereby developing themselves and AI itself.

Part 2. Potential and tasks of AI in higher education

Considering the essence of AI, which we adhere to in this article, a qualified specialist must be ready to perceive any innovative solution, able to constantly develop his mental activity in the field of his profession. The main qualification quality of a graduate of our time who has a higher education is not just to have knowledge and skills base, abilities within the framework of his profession, but to understand the main modern and promising trends, considering which to have the ability to implement his activities in the conditions of working with intelligent technologies. This means that a university graduate must acquire the skill of continuous self-development considering AI tools.

Many scientists and practitioners note that despite the gradual improvement of legislation in the field of digital technologies, insufficient attention is paid to the issues of using AI technologies in the university education system. The question: "In what format should AI be used in the higher education system" is discussed at many seminars, forums, and platforms. At the Russian forum on AI in higher education (June 28–30, 2024 in Tyumen), it was noted that "On the one hand, we are witnessing the rapid development of technologies, when literally every month AI solutions appear that seemed impossible to implement six months ago. On the other hand, the university system is inherently inertial and introduces innovations more slowly than businesses. As a result, the gap between university pedagogical formats, educational models and organizational structure, on the one hand, and the opportunities that AI opens, on the other, is steadily growing" [20]. The conclusion that should be drawn from this and other similar publications is that in the era of AI implementation, a fundamental change in approaches to the educational process in universities will be required. The existing system of education (let's call it traditional) in the university today is characterized for most specialties as a passive acquisition of knowledge.

Of course, at present the possibilities for conducting lectures are wider and more visual than a couple of decades ago: interactive systems are used, in their absence – project presentation systems, visual information is provided.

A positive element of modernity is the availability of electronic educational and methodological complexes, electronic methodological manuals for conducting practical and laboratory classes, available to the student at any time, thanks to modern devices.

On the other hand, the availability of electronic sources weakens the systematicity and progressiveness in the acquisition of knowledge by students, instils the hope of "I'll read it later".

The presence of mobile phones in students distracts from listening and deep understanding of the topic, answers to questions are found on the Internet without hesitation. In addition, the use of electronic mini tools used by students when passing the exam, and the presence of which is difficult for the teacher to detect, allows you to mislead the teacher regarding the assessment of knowledge.

All the innovative possibilities and achievements of modern gadgets are useful and deserve approval, but with the traditional way of organizing the learning process, they contribute to a decrease in the effectiveness of learning, students do not learn to think, remember and, accordingly, make independent decisions. Of course, the main role in presenting information in organizing the lecture process belongs to the teacher, but even the most wonderful speaker with interesting presentation materials significantly reduces the effectiveness of the acquired competencies in relation to the level of modern competence requirements in the context of digitalization and AI.

The memorandum adopted following the Forum "AI in Higher Education: Pedagogical Challenges and Prospects of Russian Universities", which took place on June 28–30, 2024 in Tyumen, noted that "the tasks of training highly qualified specialists are becoming more complex in our time: there should be not subordinating of a student to AI, but moving him to the position of a subject of cognition and activity, capable of creatively using and developing AI as a working tool" [20].

The inevitability of the promising use of AI technologies in the educational system already today requires a constant search for effective system tools and experimentation with various innovative educational techniques. It also does not seem possible to quickly and widely implement the idea of using AI in the educational process for all universities. This also depends on specialties and disciplines. Specialized universities or divisions of universities that train specialists related to computer science (engineering, digital technologies, programming) are in an advantageous position. These educational institutions have the appropriate material and technical base and qualified faculty in the field of digital infrastructure and AI.

Some technical specialties (in the fields of mechanical engineering, energy, instrument making and others) also have trends close to interaction with AI, for which classes are conducted using equipment and specialized technologies that are elements of AI. For example, additive technologies in manufacturing. But in addition to specialties related to computer science, many specialists are graduated from other industries that are very necessary for the country's economy. For many specialties, the potential of AI is not used at all or is used chaotically and insignificantly. There is a problem of having an appropriate material and technical base, as well as the selection and acquisition of educational software tools.

What AI content systems for training are available today on the global network. The most famous generative technologies are ChatGPT, Gemini, Llama, developed and supported by large technological giants OpenAL, GOOGLE, Facebook. Perhaps in the future, there will be many smaller, more accessible specialized models in the world. It is no secret that some students turn to ChatGPT to complete their term papers, theses, and projects. This is a text generative application. But the system generates the information that is in the database. Is the process of com-

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pleting work with the involvement of AI and the resulting product useful for students? If the student does not participate in the generation, then it is not useful. A competent teacher will immediately determine that the work was not completed by the student. This chat will be useful if the student interacts with the generator. Asks questions, thereby clarifying and adjusting the requirements. At the same time, the chat replenishes its database on a specific issue and learns to formulate an answer in accordance with the questions, that is, it self-learns. There is also a benefit for the student, since questions must be formulated. Without knowledge, you cannot formulate a question. So, after all, the student needs to acquire competencies. Thus, interest in learning appears through gamification (increasing interest in learning through play).

It is also useful for a teacher to use these generators to search for information, create interesting lectures, visual materials, presentations, projects and research, etc. In higher education, it is necessary to develop a system that provides for increasingly independent mastering of educational material by students under the supervision of a teacher. This increases the efficiency of knowledge acquisition and teaches independent thinking. An important aspect is the manageability of the educational process with the involvement of AI for the preparation of modern qualified specialists for all sectors of the economy, which should begin at the state level. It is advisable to have a consolidating body that will be engaged in the development of methodological approaches to the educational process with the involvement of AI technologies in universities in future.

Conclusion

Based on the conducted study of the essence of the modern understanding of AI and the identification of the main features characterizing AI, the author's definition of the concept is proposed: "Artificial intelligence is an area of computer science that explores methods and technologies based on the principles of operation of artificial neural networks, allowing computer systems, taking into account large amounts of information (BIG DATA), to perform tasks comparable to human cognitive abilities."

The inevitability of the introduction of AI into the national economy and social life of society leads to a natural need to transform the learning process at universities, the essence of which is the introduction of AI in the process of higher education.

Benefits of transforming the learning process in terms of involving AI:

the attractiveness of learning through gamification increases;

student interest increases due to increased conversion from learning. By setting tasks for the generator, the student becomes interested in the result. To ask a question, you need to know something yourself;

it becomes possible to create educational content based on curriculum standards and student levels;

improving the training strategy due to the need to analyze the interaction of AI with students;

ensuring the training of specialists who meet the requirements of a high-tech developing economy, who are capable of self-study and have the need to implement their activities in conditions of work with highly intelligent technologies.

There are also problems in connection with the upcoming transformation, which can be called tasks, since they need to be solved:

financial investments are required for the development of products, their implementation and training of teachers, development of the material and technical base;

systemic methodological and effective educational solutions aimed at the use of AI tools in education will be required at the state level;

overcoming the inertia, and sometimes outright skepticism of most of the teaching community regarding AI in relation to the higher education system.

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