CHAPTER «PHISICAL AND MATHEMATICAL SCIENCES»

ARTIFICIAL INTELLIGENCE FOR STUDYING MATHEMATICS

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Abstract. The monograph is devoted to the study of issues related to the use of artificial intelligence for solving mathematical problems. The prerequisites for the emergence and features of artificial intelligence as an international product for solving mathematical problems are summarized. The analysis of the application of artificial intelligence in the mathematical sphere is carried out. The prospects for the development of artificial intelligence, the main predictions and advantages of its capabilities in the near future are outlined. *Value.* The information age is increasingly exacerbating the issue of the use of artificial intelligence – and not only at the level of scientific laboratories and industrial enterprises. Today, its penetration into everyday life is already a given that a person is not always aware of. The level of penetration of artificial intelligence is already such that leading experts express opinions on streamlining the pace of its development. In this regard, the study of issues related to artificial intelligence acquires special importance, which determines the relevance of the chosen topic and the expediency of conducting research to develop this issue. Artificial intelligence has forever changed education around the world, as educators, scientists, futurologists, and other experts say. Interestingly, there are currently powerful discussions underway, the problematic issue of which is what is more from this – benefit or harm. It is now difficult to predict exactly how AI will be involved in education in the coming years, how powerfully, how much support it will receive from applicants and providers of educational services. But it can be said with

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absolute certainty that AI in education can no longer be ignored. Teachers and students of Ukraine, despite the fact that the exhausting war continues, have the opportunity to explore the possibilities of AI and involve them in the educational process at different stages – from preparing for classes to completing individual tasks. That is why today we increasingly come across studies related to the role of AI in the educational process. *Methodology.* For a long time, mathematics teachers have learned to use the most advanced technologies in order to interest the younger generation as much as possible. Before the advent of computers, mathematics teachers used calculations, etc. Modern technologies allow the teacher to activate cognitive activity. The Ministry of Education and Science of Ukraine pays special attention to the use of information technologies in the study of mathematics in primary, secondary and complete general education institutions, as well as in higher education institutions. Modern technologies increase the effectiveness of learning, the transition to a new level of mathematics learning. Today, there are a large number of publications that cover this topic. The reviewed publications describe the features of the use of artificial intelligence in the modern world. The topic of this monograph was considered in the works of Oksana Pasichnyk, Elon Musk, Stephen Hawking and others. *Results.* The modern education system requires the widespread introduction of modern technologies into pedagogical practice. Unfortunately, despite the need to introduce distance learning and free access to artificial intelligence, it is necessary to talk not only about the obvious and numerous advantages of this type of learning, but also about its disadvantages. Everyone will agree that not only the study of specific educational material with the help of artificial intelligence, but also the formation of computer, functional, subject literacy are advantages in this problem. *The purpose.* In this monograph, we will study and consider the prospects for using artificial intelligence to study mathematical topics. *Practical implications.* In conclusion, artificial intelligence has great potential for use in the educational process, but how integrated it should be is something that needs to be decided. It is also necessary to weigh both the advantages and disadvantages of such technological advancements in education so that they can be used as equitably as possible. Exploring how artificial intelligence can shake the foundation of the existing education system, highlighting its positive consequences, is a very timely measure to ensure the education system.

1. Introduction

The use of artificial intelligence has reached such a level that it has become deeply rooted in modern society, and it is simply impossible to deny its impact on education. The essence of the chosen topic – "Artificial Intelligence for the Study of Mathematics" – is obvious. We must try to understand how modern technologies can facilitate or impair the understanding of any information. More specifically, we will assess the impact of artificial intelligence on various aspects of the study of mathematics. Let us consider the study of all aspects of the application of artificial intelligence in education, an overview of the key factors associated with it and ensuring its effectiveness.

The topic was chosen for a number of reasons. As teachers of a higher education institution, we notice how artificial intelligence is integrated into teaching. We see what is happening around students, so it is interesting to understand how this will affect the learning outcome. In addition, analyzing the impact of artificial intelligence on some aspects of human life is of paramount importance, since it will shape how future generations will perceive the world.

Artificial intelligence burst into the lives of educators with the opening of access to the ChatGPT service in November 2022. But during this time there have been so many discussions, articles, posts, round tables, seminars and workshops about AI that it seems that it has been with us for a long time [5].

But in reality it does not seem so. Because artificial intelligence technologies, including those that underlie the famous ChatGPT, have existed for more than a decade. YouTube or online store recommendation algorithms, fingerprint recognition, voice typing, and map navigation are all examples of the use of certain AI technologies.

The availability of huge amounts of data, combined with the openness of access, has created an unprecedented wave of interest in ChatGPT from ordinary Internet users. It took the service only 5 days to attract the first million users to its site.

For comparison, Facebook achieved such indicators in 10 months, and Netflix in 3.5 years. Even for the dynamic field of information technology, these indicators are impressive [6].

Let's explore the impact of AI on the education system. Let's discuss the benefits of AI in the classroom, including personalized learning, assessment and evaluation, as well as student support and engagement. We will also look at the challenges and issues of artificial intelligence in education, such as privacy and bias, as well as ethical considerations related to AI-based education.

2. The history of the formation of artificial intelligence

Today, artificial intelligence technologies cover almost all areas of our lives and are presented as super-new achievements of scientists. In fact, the concept of artificial intelligence appeared back in the 1950s, and the main issues have not changed significantly since then [4].

Until 1949, computers lacked a key element in order to talk about any intelligence, namely memory. They could execute commands, but could not store them, as well as information about the commands they had already executed. In addition, using such computers was a very expensive pleasure, available only to the most prestigious universities and large technical companies. So, in modern money, renting one computer for a month cost about $ 200 thousand [4].

So serious research in the field of artificial intelligence required significant funding, which could become a reality only if there were at least some initial results in this direction, and not just images of a smart computer program from science fiction. The first such result was the program “Logic Theorist”, which imitated the human approach to solving problems. It was presented at a scientific conference at Dartmouth College (New Hampshire, USA) in 1956, where the concept of “artificial intelligence” was actually invented [4].

1957-1974 was the heyday of artificial intelligence. Computers could store more and more information, became faster, cheaper and more accessible. Similarly, machine learning algorithms improved – computer programs coped better with solving problems, and in 1966 the first virtual interlocutor was even created – Eliza, who became the prototype of modern chatbots and virtual assistants.

The first successes, as well as the confidence of leading scientists in the great prospects of artificial intelligence, led to funding in this field, primarily state funding. The U.S. Department of Defense’s research agency

was particularly interested in speech recognition and translation technology. Optimism and expectations were high indeed. In 1965, Herbert Simon, the Nobel Prize winner in economics, wrote: "Within the next 20 years, machines will be able to do any job that a human can do." Another leading AI expert of the time, Marvin Minsky, stated in 1970 that "within 3 to 8 years, we will have a machine with the general intelligence of the average human." However, the early successes of AI algorithms also demonstrated the enormous number of obstacles to real machine intelligence. The biggest obstacle was the lack of computing power. For example, in order to function as a virtual conversationalist, a machine must memorize the meanings of many words and understand their meanings in many combinations. The computers of that time could not store the necessary amounts of information and process it quickly enough. So, the extremely high interest gave way to disappointment, funding decreased, as did the amount of research, and the period from 1974 to the early 1980s was called the first "winter" of artificial intelligence.

Then there was a short period of renewed interest in machine learning technologies, when the first expert systems appeared, allowing machines to imitate the decision-making process of a human expert, and the Japanese and British governments, interested in the relevant technologies, began to actively finance the industry. However, already in 1987, the second "winter" of artificial intelligence began, which lasted until 1993 [4].

Then, during the 1990s and 2000s, artificial intelligence developed, despite the lack of government funding and significant public attention. The main role in the development of machine learning technologies passed to large technical companies, which managed to achieve noticeable successes on the way to an intelligent machine. For example, in 1997, an IBM computer program defeated the reigning world chess champion Garry Kasparov. That same year, Windows introduced speech recognition software developed by Dragon Systems, and in 2001, a team of researchers from MIT introduced the first social robot named Kismet, which learned to recognize human emotions. It seemed that there were no problems that machines could not solve [4].

Indeed, the limitations in computing power of computers ceased to be a problem. According to Moore's Law, the memory and speed of computers double every year, and from a certain point on, computing power became

sufficient for new achievements in the field of artificial intelligence. It was thanks to the large amount of memory and high speed that the computer was able to defeat Garry Kasparov in 1997 and the Chinese Go champion Ke Jie in 2017.

Interestingly, the approaches to programming artificial intelligence themselves have not undergone any revolutionary changes over the past 30 years. All the successful implementations of machine learning algorithms that we can observe in banking, marketing, computer games, robotics, the development of virtual assistants, etc., rely on the huge amounts of data and computing power that we have access to today. Thus, in fact, most new tasks are solved by brute force. For example, a breakthrough in the recognition of objects depicted in pictures by artificial intelligence occurred after the introduction of the ImageNet database, which has 14 million photos manually labeled by people who indicated what objects are depicted in these photos.

The recent successes of artificial intelligence in the field of computer games, when machines beat world champions in StarCraft and Dota 2, owe their success to a class of machine learning algorithms called reinforcement learning. The effectiveness of these algorithms is actually based on the enormous computing power available today, which allows machines to simulate tens of thousands of years of computer games, during which the algorithm learns from its own mistakes and reaches the level of world champions. That is, again, new tasks are solved primarily by brute force. Of course, some important innovations still occur. For example, in 2014, a new class of artificial intelligence algorithms was proposed – generative adversarial networks, which today allow the creation of artificial images that are practically indistinguishable from real photographs. In 2017, after the introduction of a new deep learning model called Transformer, there was a breakthrough in artificial intelligence algorithms that deal with text recognition and generation. Machines have learned to generate entire articles of sufficiently meaningful and logical text on a given topic, and today you can already find product descriptions on websites and even advertising slogans created by artificial intelligence algorithms.

Also read: Should children learn human values from algorithms?

Virtual assistants are communicating better and better, and it seems that driverless cars are a matter of the coming years. However, the creation

of true artificial intelligence, which would be equal to the intelligence of the average person in terms of its versatility and efficiency, still remains an unsolved task. Moreover, leading scientists in the field of artificial intelligence have very vague ideas about the direction in which science should move in order to eventually get closer to creating intelligent machines. It is obvious that the methods currently used to solve, for example, tasks of recognizing objects in pictures cannot be the only tool for creating universal artificial intelligence – if millions of manually made labels were needed for this one task alone, how many will be needed to solve all the other tasks that are within the power of human intelligence? Of course, scientists have some ideas about promising directions for the development of artificial intelligence, but so far there is no obvious path to creating truly intelligent and universal machines. Therefore, some believe that we should expect another "winter" of artificial intelligence, when interest in this topic will decline, as well as the number of new ideas in scientific research. Although, given that artificial intelligence already has practical applications in many areas, this topic is unlikely to completely fade away [5].

3. Research and testing of artificial intelligence functions

Let's start with statistics. In September-October 2023, Ukraine conducted an All-Ukrainian study of the prospects of artificial intelligence in school education. Its organizers were the Minor Academy of Sciences of Ukraine and the Projector Institute. The study was attended by 1,747 teachers and 1,443 students in grades 8–11 from all over Ukraine, except for the occupied territories. 70% of teachers have already used at least one artificial intelligence tool in the last 6 months. In total, 76% of educators have used artificial intelligence, and half of them had a positive experience. Every second teacher believes that artificial intelligence will change the educational process in the coming years, using it to prepare for classes, create tests, conduct lessons, test knowledge, and do extracurricular work. Among students, 60% have already used artificial intelligence for homework, 85% at least once, and a third every week. About 40% used it during lessons, mainly to search for and organize information, create notes, generate ideas, titles and abstracts. Although some anonymously admit to using AI for copying, this is less common. The study shows that most teachers and students are already actively using AI in teaching. Teachers

use it to prepare materials, and students use it to complete assignments. This indicates a significant impact of AI on the educational process [2].

Artificial intelligence greatly simplifies access to educational resources to make it easier to master mathematical material. Personalized learning is another important advantage, because thanks to AI, individual lesson plans can be created. This helps each student learn at their own pace and receive support exactly where they are struggling. Also, automating routine tasks, such as grading work, frees up teachers' time for something more important, such as developing new programs. And, of course, distance learning using artificial intelligence makes education more accessible, which is especially important in the context of global problems, for example, COVID-19. But, where there are advantages, there are, of course, disadvantages. The use of artificial intelligence leads to dependence on it and other technologies, reduces independent thinking. Educators simply become passive consumers of information, relying on artificial intelligence, instead of developing their own skills. Also, the information from artificial intelligence does not always meet certain standards or does not take into account the student's own needs. The risk is that artificial intelligence will provide standardized answers to unique questions, which reduces the quality of learning [1].

Let's focus in more detail on mathematics. Learning mathematics with the help of artificial intelligence has its advantages and disadvantages. Artificial intelligence can and can explain complex concepts through visualization and interactive examples, which contributes to the assimilation of the material. Artificial intelligence algorithms can solve problems, not always correctly, but they help students understand the methods for solving a particular problem. By the way, artificial intelligence can also analyze errors and provide recommendations for their correction. However, on the other hand, excessive use of artificial intelligence always leads to passive learning, when the student relies entirely on technology instead of independent thinking. Also, excessive dependence on artificial intelligence leads to the loss of manual calculation skills and ordinary analytical thinking. For example, in the case of studying analytical mathematics, artificial intelligence can automate data analysis and calculation of certain mathematical models, which will allow the student to focus on interpreting the results and developing new approaches. Artificial intelligence also allows you to work with large amounts of data, which can contribute to the

development of analytical skills. However, the complexity of understanding artificial intelligence algorithms becomes an obstacle for students [2].

Consider another example from higher mathematics – matrices. A student can use artificial intelligence for calculations, but first he must master the basics on his own, and only then use calculators or artificial intelligence. In addition, artificial intelligence does not always perform calculations correctly, because it is a machine that can make mistakes, just like a person. However, artificial intelligence is great for explaining theory, because it has access to a large database from which you can get precise definitions and clear explanations. Therefore, speaking of theory, we can really recommend the use of artificial intelligence. Regarding calculations, it is worth noting that it performs them according to its own algorithm, and even if you have indicated a specific method to it, its method will not always be the simplest or most convenient for you. Sometimes the result may be correct, but the solution process itself will be more complicated than if you did it yourself.

For comparison, let's take the following task: Solve a system of equations using the Gauss method. Let's first consider how such an example is solved in educational institutions:

$$\begin{cases} 2x + y + 3z = 9 \\ x - 2y + z = -2 \\ 3x + 2y + 2z = 7 \end{cases}$$

$$A = \left(\begin{array}{ccc|c} 2 & 1 & 3 & 9 \\ 1 & -2 & 1 & -2 \\ 3 & 2 & 2 & 7 \end{array}\right) \sim \left(\begin{array}{ccc|c} 1 & -2 & 1 & -2 \\ 2 & 1 & 3 & 9 \\ 3 & 2 & 2 & 7 \end{array}\right) \begin{matrix} a_1 \\ a_2 - 2a_1 \\ a_3 - 3a_1 \end{matrix}$$

$$\left(\begin{array}{ccc|c} 1 & -2 & 1 & -2 \\ 0 & 5 & 1 & 13 \\ 0 & 8 & -1 & 13 \end{array}\right) \begin{matrix} a_1 \\ a_2 \\ 5a_3 - 8a_2 \end{matrix} \sim \left(\begin{array}{ccc|c} 1 & -2 & 1 & -2 \\ 0 & 5 & 1 & 13 \\ 0 & 0 & -13 & -39 \end{array}\right)$$

$$\begin{cases} x - 2y + z = -2 \\ 5y + z = 13 \\ -13z = -39 \end{cases}$$

$$z = -39 / (-13) = 3$$

$$y = (13 - 3) / 5 = 2$$
$$x = -2 + 2 * 2 - 3 = -1$$

Respond: x = -1; y = 2; z = 3.

Now, for example, let's take this example and ask artificial intelligence (chatGPT) to solve it:

$$\begin{cases} 2x + y + 3z = 9 \\ x - 2y + z = -2 \\ 3x + 2y + 2z = 7 \end{cases}$$

To solve a system of equations using the Gauss method, we first write the system in matrix form:

$$\left(\begin{array}{ccc|c} 2 & 1 & 3 & 9 \\ 1 & -2 & 1 & -2 \\ 3 & 2 & 2 & 7 \end{array}\right)$$

Now we will transform this matrix into upper triangular form.

1. We will use the first equation to calculate the new values of the second and third equations.

From the first row, we will multiply it by 1/2 and subtract it from the second row:

$$\left(\begin{array}{ccc|c} 2 & 1 & 3 & 9 \\ 0 & -2.5 & -0.5 & -6.5 \\ 3 & 2 & 2 & 7 \end{array}\right)$$

Now subtract 3/2 of the first row from the third row:

$$\left(\begin{array}{ccc|c} 2 & 1 & 3 & 9 \\ 0 & -2.5 & -0.5 & -6.5 \\ 0 & 0.5 & -2.5 & -6.5 \end{array}\right)$$

Now divide the second row (P2) by -2.5 to get a unit on the diagonal:

$$\left(\begin{array}{ccc|c} 2 & 1 & 3 & 9 \\ 0 & 1 & 0.2 & 2.6 \\ 0 & 0.5 & -2.5 & -6.5 \end{array}\right)$$

3. Subtract 0.5 from the third line (P3):

$$\left(\begin{array}{ccc|c} 2 & 1 & 3 & 9 \\ 0 & 1 & 0.2 & 2.6 \\ 0 & 0 & -2.6 & -7.3 \end{array}\right)$$

4. From the third line, divide by -2.6:

$$\left(\begin{array}{ccc|c} 2 & 1 & 3 & 9 \\ 0 & 1 & 0.2 & 2.6 \\ 0 & 0 & 1 & 2.8 \end{array}\right)$$

5. Now we will work with the second and first rows. We will subtract 0.2 from the second row:

$$\left(\begin{array}{ccc|c} 2 & 1 & 3 & 9 \\ 0 & 1 & 0 & 2.2 \\ 0 & 0 & 1 & 2.8 \end{array}\right)$$

6. Subtract 3P3 from the first row:

$$\left(\begin{array}{ccc|c} 2 & 1 & 0 & -0.4 \\ 0 & 1 & 0 & 2.2 \\ 0 & 0 & 1 & 2.8 \end{array}\right)$$

7. Subtract P2 from the first row:

$$\left(\begin{array}{ccc|c} 2 & 0 & 0 & -2.6 \\ 0 & 1 & 0 & 2.2 \\ 0 & 0 & 1 & 2.8 \end{array}\right)$$

8. Now let's divide the first line by 2:

$$\left(\begin{array}{ccc|c} 1 & 0 & 0 & -1.3 \\ 0 & 1 & 0 & 2.2 \\ 0 & 0 & 1 & 2.8 \end{array}\right)$$

As a result, we get:

Therefore, the solution to the system of equations:

x = -1.3, y = 2.2, z = 2.8.

Having received such results, we see that the result of solving the system of linear equations is completely incorrect. The method that artificial intelligence used to solve the example is quite inconvenient and

has many steps. Therefore, let's turn to artificial intelligence, but already on the ChatINFO platform. Let's suggest that artificial intelligence on this platform solve this system of linear equations using the Gauss method:

$$\begin{cases} 2x + y + 3z = 9 \\ x - 2y + z = -2 \\ 3x + 2y + 2z = 7 \end{cases}$$

Step 1: Write the system in the form of an augmented matrix:

$$\left(\begin{array}{ccc|c} 2 & 1 & 3 & 9 \\ 1 & -2 & 1 & -2 \\ 3 & 2 & 2 & 7 \end{array}\right)$$

Step 2: Swap the first and second lines to get a unit in the first place:

$$\left(\begin{array}{ccc|c} 1 & -2 & 1 & -2 \\ 2 & 1 & 3 & 9 \\ 3 & 2 & 2 & 7 \end{array}\right)$$

Step 3: Let's reduce the first element of the second and third rows to zero:
For the second row: R2 = R2 – 2R1
For the third row: R3 = R3 – 3R1

We get: $\left(\begin{array}{ccc|c} 1 & -2 & 1 & -2 \\ 0 & 5 & 1 & 13 \\ 0 & 8 & -1 & 13 \end{array}\right)$

Step 4: Let's reduce the second element of the third row to zero:
R3 = R3 – 8/5R2

We get: $\left(\begin{array}{ccc|c} 1 & -2 & 1 & -2 \\ 0 & 5 & 1 & 13 \\ 0 & 0 & -13/5 & -39/5 \end{array}\right)$

Step 5: Solve the system with an upper triangular matrix:
From the third row:

$$-13/5z = -39/5$$
$$z = 3.$$

From the second line:

$$5y + z = 13$$
$$y = 2.$$

From the first line:

$$x - 2y + z = -2$$
$$x - 4 + 3 = -2$$
$$x = -1.$$

Respond:

$$x = -1; y = 2; z = 3.$$

Having received such a result, we conclude that this chat has taken the right steps to solve systems of linear equations, received a small amount of recording, and provided a detailed explanation. This solution is very similar to the solution in regular classes with a teacher.

I must note that before turning to artificial intelligence, you need to be aware and understand exactly what answer we should get in the end.

4. Artificial Intelligence in Education

Artificial intelligence (AI) is no longer a buzzword, it has become an integral part of our daily lives. From virtual assistants like Siri and Alexa to self-driving cars, AI has transformed the way we live and work. But what about education? Can AI improve the way we learn and teach?

As we delve into the future of AI in education, we will explore the potential impact on the education system and how we prepare students for the workforce of tomorrow. This publication will provide valuable insights into the role of AI in education and how it can shape the future of learning [6].

Introduction to AI and its role in education. Artificial intelligence (AI) is changing the world as we know it, and the education system is no exception. AI has become an effective tool for solving problems in education and accelerating progress towards SDG 4. Through its ability to collect and analyze data, AI can inform educators about student engagement, learning progress, and well-being. It also has built-in digital applications and tools that allow for interaction with the teacher and individual monitoring of progress.

AI has the potential to transform education by optimizing teaching and learning processes through personalized learning algorithms. By identifying the strengths and weaknesses of each student, AI can adapt learning materials to individual needs. Virtual reality experiences can be created without leaving the classroom to communicate with students in

distant countries or to showcase historical sites that are at risk of excessive environmental damage if used for a long time; this provides students with an interactive learning environment that improves retention of understanding.

Augmented reality technology, powered by artificial intelligence, promises a more immersive learning experience for students, allowing them to interact with virtual objects in ways that were previously impossible. By overlaying real-time information on what people see around them using devices or smartphones on smart boards or screens in classrooms, it creates new immersive experiences, changing the way information is effectively shared [7].

While the benefits of artificial intelligence in education are enormous, policymakers must identify the risks associated with fully implementing these technologies. The use of sensitive data raises questions of privacy or fairness, requiring transparent policies on how such data is collected, stored, and shared with stakeholders, who must critically consider whether they are advancing their pedagogical goals through technological innovation, rather than reinforcing existing biases, ingrained curricular practices that limit creativity, critical thinking, or diversity, among other issues, while initiating incremental improvements using machine-generated ideas or insights.

Benefits of AI in Education. One of the most compelling benefits of AI in education is personalized learning. AI-powered systems can generate individualized lesson plans and assessments for each student based on their unique learning abilities and needs. This ensures that students receive an optimized learning experience, leading to greater engagement and better performance.

AI can also provide better access to education for students with special needs. With intelligent learning systems, AI-powered devices can identify areas where a student needs extra support and provide personalized instruction accordingly. This helps students who may need extra time or help with certain subjects keep up with their peers [6].

Another benefit of AI in education is that it allows for real-time problem-solving assessment. Teachers can use this technology to track how well their students are understanding concepts, tracking individual progress throughout a lesson or course. In doing so, they learn about areas that need more attention and thus offer specific solutions [7].

Finally, immersive virtual reality (VR) experiences are now available thanks to advances in AI research in machine vision algorithms called SLAM (simultaneous localization and mapping), which allow computers to create maps from camera input, making VR games like Pokémon Go possible! The University of Southern California's Institute for Creative Technologies found that soldiers learn faster by using these simulations rather than reading instructions during training simulations.

Overall, the benefits of AI are changing the way we teach and learn in amazing ways; it provides diverse opportunities for students around the world, regardless of their individual circumstances.

Personalized learning powered by AI. AI is changing the educational landscape by providing students with personalized learning experiences. Personalized learning increases student engagement and motivation, which are key factors in their academic success. AI can capture, aggregate, and analyze data to create learning profiles for students. By analyzing data about each individual's learning preferences, strengths, and weaknesses, AI can suggest personalized learning experiences and provide additional learning when needed.

In addition to personalized support for students, AI analytics can also enable teachers and administrators to make more informed decisions. By collecting vast amounts of student data, from assessment templates to test scores, presented in user-friendly dashboards or reports from AI platforms, educators can gain insights into critical areas for improvement, such as effectively tracking student progress over time, optimizing curricula based on real-time classroom needs analysis, or understanding which topics are most challenging.

The ability of AI-powered personalized learning systems to assess vast amounts of student information makes it clear that equitable access to information resources must be ensured so as not to exacerbate inequalities between students of different income levels or backgrounds through increasingly supported technologies. rather than isolating tools used outside of educational settings [6].

Personalized learning powered by AI offers many benefits in terms of increasing engagement and motivation among students, and also allows teachers and administrators to make more informed decisions. The framework created by these technologies will undoubtedly prove useful in

developing an education system that is more inclusive while serving all groups of learners equally.

AI-powered assessment and evaluation. Assessment and evaluation using artificial intelligence is fundamentally changing the rules of the education system. AI has the potential to increase the accuracy, efficiency, and fairness of assessments. With the help of artificial intelligence, student learning can be measured more accurately, providing deeper insights and facilitating individualized learning processes [4].

AI can automate administrative tasks such as test scoring, allowing teachers to focus more time on teaching rather than on scoring tests. Using artificial intelligence to grade essays can not only save time, but also provide instant feedback to students. In addition, AI-powered assessments can improve physical and cybersecurity through biometric solutions.

One of the most important advantages of using AI for assessment is its ability to prioritize candidates based solely on their merit, while minimizing human biases related to student demographics such as race or gender. This contributes to a fairer system where students are assessed based on their skills rather than any other discriminatory factors.

Europe has proposed a legislative framework for AI that takes into account the risks associated with biased decisions or erroneous automated judgments during assessment. It is therefore important that schools planning to implement this technology ensure that they adhere to strict ethical guidelines when using these powerful systems.

AI-powered assessment and evaluation will be an important tool for modernizing the education system, making assessments faster, more impartial and effective in identifying areas where students need help; thereby better preparing them for a successful future in their respective fields [5].

AI-powered student support and engagement. With the rise of artificial intelligence (AI), the education system has embraced the technology to improve student interaction and support. One way AI is being used in the classroom is through chatbots. These chatbots offer students a personalized and interactive learning experience, providing 24/7 support and improving accessibility. By creating unique conversations with each student, AI-powered chatbots can help teachers manage large class sizes.

AI technology also provides data analytics that can help teachers stay on top of their students' progress, engagement, and well-being. With this information at their fingertips, teachers can tailor their lessons to individual needs and identify areas where students need extra help.

Additionally, introducing AI concepts early on can help students be digitally ready for future academic success. Educators play a role in educating students on the ethics of using AI while demonstrating practical applications for its use in academic areas such as emotional well-being and optimizing educational procedures.

In summary, it is clear that AI technology has enormous potential to improve student engagement and support. From creating unique conversations with each student through chatbots to advanced data analytics for teachers to track each student's learning journey, these tools are resources that create personal connections between revolutionary technologies and human interaction to achieve optimal learning outcomes in today's classrooms.

Challenges and concerns of AI in education. The integration of artificial intelligence (AI) into education has raised various challenges and concerns that have transcended policy debates and regulatory frameworks. Privacy breaches are one of the main risks; students and teachers may have negative attitudes towards AI systems. Therefore, it is necessary to take steps to ensure data security while leveraging the benefits of technology [7].

Another important issue is the accessibility of AI-based tools and platforms. To make technology inclusive, we must provide equal opportunities regardless of socioeconomic status or location. However, there are concerns that AI will perpetuate existing biases and discrimination in education. This is especially true with personalized learning materials that may reinforce values associated with cultures or ethnic groups, whether intentionally or not.

Policymakers and district leaders should ensure that they implement AI programs with consideration of the potential benefits and risks, without disregarding ethical issues. They should promote informed consent, as it is fundamental when using certain types of personalized learning technologies that involve collecting personal data from students. The best way to address these ethical dilemmas is to adhere to the principles of transparency in educational institutions.

Artificial intelligence has the potential to effectively overcome various obstacles in education, such as innovative teaching practices. However, this presents a myriad of unknowns, as successful assessment cannot currently be measured solely on the basis of conventional parameters such as grades or classroom performance assessments by teachers alone, taking into account all the considerations necessary before effectively implementing automated assessment systems in national education systems today.

Ethical Considerations in AI-Based Education. AI has the potential to revolutionize education, but its implementation and use come with ethical challenges. These challenges include privacy and surveillance, bias and discrimination, and the role of human judgment. As artificial intelligence becomes more prevalent in education systems around the world, it is important to educate teachers and students about these ethical considerations [6].

One of the biggest concerns with AI in education is privacy. As more and more student data is collected and stored on AI-based online platforms, schools must take steps to ensure the privacy of this information to avoid any breaches or leaks. Surveillance is also a concern as facial recognition technology becomes increasingly common in schools. Its use can lead to unethical tracking of students' movements if not properly monitored.

Bias and discrimination are other areas where AI could be a problem in education. The algorithms behind these technologies could perpetuate existing biases, further marginalizing underrepresented groups such as women or ethnic minorities. In addition, this raises concerns about making decisions based on data that may be incomplete or unreliable.

Furthermore, while AI-based systems can effectively combat plagiarism and plagiarism through advanced detection tools that analyze writing styles for similarities in files submitted by different students, ethical concerns remain about the balance between academic integrity and individual learning needs.

As rapid technological progress outpaces policy debates and regulatory frameworks at the international level; stakeholders at all levels must work together to create policies that are informed by ethical considerations, while finding ways to safely harness the benefits of AI technologies for all parties involved; thus ultimately promoting the responsible use of such tools in educational institutions around the world. This will help open up new

opportunities that will contribute to progress in ensuring access to quality learning experiences, thus achieving successful outcomes in the long term for current generations as well as for future generations!

The Future of AI in Education and its Potential Impact. AI is poised to revolutionize education and solve long-standing problems in the field. With the education AI market set to reach $20 billion by 2027, there is no doubt that this technology has a bright future in classrooms around the world [5].

One of the key benefits of AI in education is its ability to reduce the workload of teachers and streamline administrative tasks. Personalized learning, automated grading, and intelligent instructional systems are just a few of the ways in which AI is changing the way students learn and the way educators work. By automating routine tasks, teachers will have more time for personal interaction with students or to focus on more creative aspects of teaching.

However, there are concerns about the effectiveness of AI-based educational products and services. While these technologies can provide personalized feedback, they may not be able to fully replicate human interactions. In addition, there is a need for policy debate and regulatory frameworks for the ethical use of data collected from students.

Despite these concerns, it is clear that AI has enormous potential to unlock productivity and potential in education. As schools continue to adapt to modern technological advances through AI solutions, we can expect further growth in this sector, with an emphasis on optimizing effective communication between teachers and students, while creating intelligent constructs that facilitate socialization among peers – whether remotely or within the physical setting of the classroom.

Artificial intelligence and robotics are two extraordinary areas that are constantly evolving and bringing unexpected benefits to the modern world. Their impact on our lives is becoming increasingly noticeable and interesting. These branches of science and technology open up endless possibilities and amazing discoveries that amaze with their diversity and innovation.

Artificial intelligence is a field that researches and develops technologies that give computers and other devices the ability to perform tasks that were previously considered exclusively human. This includes machine learning, pattern recognition, decision-making and much more. A large

number of modern technologies that we use every day are based on artificial intelligence – from voice assistants to production automation systems [6].

Robotics is a field that deals with the creation and development of robots that can perform a variety of tasks, providing assistance to people and contributing to progress. Robots can be used in medicine, industry, education and many other areas. They can have different shapes, sizes and functionalities, but always amaze with their unexpectedness and unusualness.

Robots can independently acquire knowledge. In the world of artificial intelligence and robotics, there are unusual facts that can surprise everyone. One of these facts is the ability of robots to learn on their own. This means that they are able to acquire knowledge and skills without direct human intervention.

Robots equipped with artificial intelligence can use a variety of algorithms and learning methods to improve their skills. They can analyze large amounts of data, identify patterns and draw conclusions. Thus, robots can independently improve their performance and adapt to new conditions [7].

For example, robots in the field of medicine can learn to recognize the symptoms of various diseases, analyze medical images and make diagnoses. They can use the accumulated knowledge and experience to improve the accuracy of their actions.

They are able to analyze information and acquire new skills without human intervention.

Artificial intelligence and robotics are unexpected and interesting fields that constantly amaze us with their capabilities. One of the most exciting features of these technologies is their ability to analyze information and acquire new skills without human intervention. This unusual phenomenon opens up endless possibilities for the development and improvement of intelligent systems and robots.

Thanks to advanced algorithms and training on large amounts of data, artificial intelligence can analyze information with speed and accuracy unattainable for humans. It can detect complex relationships and patterns that help developers and scientists solve complex tasks and problems.

However, artificial intelligence not only analyzes existing information, but is also able to independently acquire new skills and knowledge. Thanks

to machine learning and deep learning, robots can learn from their own mistakes, analyze results and improve their actions. They can adapt to changing conditions and develop without the need for constant human intervention.

These unusual capabilities of artificial intelligence and robotics have already found application in various industries, ranging from medicine and the automotive industry to science and art. Researchers and engineers are constantly working to improve these technologies to make them even more efficient and intelligent. Intelligent systems and robots that can analyze information and acquire new skills without human intervention open up a limitless world of possibilities and prospects that seemed impossible just a few decades ago.

Robots can improve their skills and evolve over time.

In the world of robotics and artificial intelligence, there are many interesting and unexpected facts that indicate how much robots can become more developed and improved over time. They are able to independently acquire new skills, adapt to changes in their environment and even improve their functionality.

One of the most interesting facts is that robots can learn by observing people. They are able to analyze the actions and movements of people and use this information to improve their own skills. For example, a robot manipulator can observe the movements of a person while performing a certain task and repeat them with accuracy and efficiency [6].

In addition, robots are able to independently adapt to changes in their environment. They can recognize new objects, learn to perform new tasks and change their strategy of actions to achieve better results. For example, a robot vacuum cleaner can automatically learn to avoid obstacles and clean the room more efficiently with each subsequent task.

One of the unusual facts is that robots can improve their functionality not only in the learning process, but also thanks to evolutionary algorithms. They can generate new variations of their programs and structures, test their effectiveness and select the best of them. Thus, robots constantly improve their skills and develop over time, which makes them more and more adaptable to various tasks and situations.

Artificial intelligence can be creative. In the field of robotics and artificial intelligence, there are unexpected and interesting facts that will surprise you

with their unusualness. One of the most interesting aspects is the creativity that artificial intelligence can show [4].

Artificial intelligence shows the ability to think creatively and create unique solutions. It can develop new ideas, draw pictures, compose music and even write literary works. This is striking in its unusualness and opens up new opportunities for the development of technologies.

One example of creative artificial intelligence is a robot artist who can create unique works of art. It uses its algorithms and skills to create paintings that amaze with their beauty and originality. This allows robotics to combine technology and art, opening up new perspectives for both industries.

Artificial intelligence can also be creative in the field of music. It can compose melodies and create musical compositions that have never been heard before. This opens up new horizons for the music industry and allows for the creation of new musical masterpieces.

Thus, artificial intelligence turns out to be not only rational, but also a creative tool that is able to surprise with its capabilities and open up new horizons for the development of technology and art.

It can create music, write books and draw pictures.

In the world of artificial intelligence, there are interesting unexpected facts that surprise with their capabilities. Artificial intelligence not only performs complex calculations and analyzes large amounts of data, but also manifests its creative essence. It is able to create music, write books and even paint pictures, surprising people with its talent.

One of the unusual manifestations of artificial intelligence is its ability to compose music. Thanks to complex algorithms and the analysis of a large number of musical works, it is able to create new melodies that can surprise even professional musicians. This allows you to create unique compositions that would be impossible to create without the participation of artificial intelligence.

Authorship of books is another area in which artificial intelligence surprises with its abilities. It can analyze a large number of literary works, study the structure and style of writing, and even create new books that are almost indistinguishable from works written by people. This opens up new opportunities for the literary world, and also calls into question the concept of authorship [4].

Another unusual talent of artificial intelligence is painting pictures. It can analyze the style of different artists, study their techniques and techniques, and create its own unique works of art. This allows not only to expand the collections of paintings in museums, but also to enrich the world of art with new works that can amaze with their beauty and originality.

Thus, artificial intelligence shows unusual abilities for creativity, can create music, write books and paint pictures. This opens up new perspectives and challenges for art, and also questions the idea of creativity and talent.

What are the basic principles of robotics? Robotics is based on the principles of mechanics, electronics and programming. The main idea is to create mechanical devices that can perform various tasks without human intervention [4].

How does artificial intelligence affect our daily lives? Artificial intelligence is now widely used in many areas, such as medicine, finance, the automotive industry and others. It helps solve complex tasks, predict trends and makes our lives easier in many aspects.

What can be the negative consequences of using artificial intelligence? One of the possible negative consequences of using artificial intelligence is the loss of jobs. Automation of processes can lead to the replacement of people by robots, which can affect the social sphere. Also, the question of the ethics of using artificial intelligence arises, especially in the field of data storage and user privacy.

What interesting facts about robotics can be noted? One of the interesting facts about robotics is that the first robots appeared in ancient times. For example, in Ancient Egypt, mechanical scorpions were created that could move. It is also worth noting that robotics is constantly evolving and future robots may have incredible capabilities that are still difficult to imagine today.

5. Conclusions

In the paradigm of the functioning of any system built on the principle of "maximum effect – minimum costs", artificial intelligence does indeed contribute to increasing its efficiency. It is important to understand that the system is characterized not by an error, but by the reaction to it. Currently, artificial intelligence cannot predict the consequences of its errors, since it is deprived of the ability to recognize factors that are outside the scope of

automated algorithms. The task today is not to abandon the development of artificial intelligence, but to optimize potential risks from it. Leading experts in this field should focus on ensuring that the results of the functioning of artificial intelligence are economically and socially significant, and not destructive. No matter how fast science develops, the only way out is to increase the level of capabilities and intelligence of the person himself. In the expression "to give artificial intelligence human abilities", the key is the person himself and the benefits that he creates.

One thing is clear: the rapid development of artificial intelligence creates not only additional opportunities and threats for its third-party consumers, but also pushes the average person to become more knowledgeable and responsible. Thus, Nick Bostrom, professor of philosophy at Oxford University, in his book "Artificial Intelligence. Stages. Threats. Strategies", concludes that the development of intelligence – both artificial and human – is inevitable. The only question is in which direction this development will be directed [7].

Artificial intelligence can be useful in solving simple geometric problems, such as calculating areas, perimeters, radii of circles, or volumes of standard shapes. It is able to quickly perform arithmetic operations and provide accurate results for such problems. However, at the moment, artificial intelligence does not have the ability to effectively solve complex geometric problems, especially those that require deep analysis of spatial shapes, such as tetrahedrons or pyramids, etc. These problems require not only mathematical calculations, but also more complex conceptual approaches, working with non-standard data or specific properties of shapes, which requires more flexibility and accuracy than artificial intelligence provides.

The modern approach to teaching mathematics is rapidly changing under the influence of technology, especially artificial intelligence, which is becoming an integral part of the educational process. As the complexity of the tasks that students face increases, AI-based tools offer new methods for solving mathematical problems, making learning more accessible and understandable.

AI is able to solve complex mathematical problems that previously required a lot of time and knowledge. This is especially important for students and scientists working with high-level mathematics, for example, in the fields of physics, engineering or finance. AI can perform numerous

calculations, analyze data and find solutions in a matter of seconds, which makes it a valuable tool for processing large amounts of information

One of the biggest advantages of AI is the ability to explain solutions step by step. Now, when a student is faced with a complex example or equation, the system not only gives the final result, but also breaks the process into understandable stages. Thanks to this approach, the student can study each step separately, which helps to better assimilate the material and understand the logic of solving the problem. This is especially important for developing analytical skills, as step-by-step explanations help students better navigate mathematical concepts and apply them in different contexts [3].

AI actively helps students develop analytical thinking by teaching them to critically approach problems and analyze different solution methods. Thanks to this approach, students learn to think flexibly, which is useful not only in mathematics, but also in solving real-world problems.

AI opens up opportunities for studying new, more complex sections of mathematics, such as linear algebra, differential equations, probability theory, and statistics. Thanks to data visualization, graphs, and interactive tools, students can more easily master new concepts that previously seemed difficult to understand on their own.

Another important aspect is the high accuracy of calculations and answers, which is guaranteed by the use of AI algorithms. Thanks to fast data analysis and complex calculations, students can be confident in the correctness of their solutions, even in cases with complicated tasks. AI is also able to detect errors in calculations and provide students with explanations of what went wrong, which makes learning not only effective but also adaptive.

In addition, AI-based tools are increasingly offering individual recommendations for each student, adapting the learning process to their specific level and needs. For example, if a student does not understand a certain topic, AI can offer additional tasks or explanations, helping to learn the material more deeply. This allows for the creation of personalized educational trajectories, which is key in developing skills for the modern world.

In general, AI tools in mathematics education are changing the idea of learning, making it more structured, accurate and personalized. This approach allows not only to achieve academic goals, but also to form analytical thinking in students, which is necessary in later life. artificial

intelligence not only makes learning mathematics easier, but also makes it deeper and more accessible to more people. Its implementation gives students and professionals the tools to succeed in today's world, where analytical skills and the ability to quickly find solutions are valued more than ever.

Yes, indeed, artificial intelligence can be a personal teacher. It is he who today expands and provides those educational opportunities that until recently were available only to a limited circle of people. Modern teachers, who use the capabilities and advantages of artificial intelligence, create and significantly expand not only their international audience, but also the quality of interaction with those they teach. In turn, this can push them not only to constant self-improvement, but also to change the content of the educational process as such – when geographical boundaries do not matter at all.

References:

1. Vykorystannia shtuchnoho intelektu [Using artificial intelligence]. Available at: https://prjctr.com/mag/aicases (accessed January 9, 2025).

2. Shtuchnyi intelekt v osviti: yak tekhnolohiia vplyvaie na navchannia v ukrainskykh shkolakh [Artificial Intelligence in Education: How Technology Affects Learning in Ukrainian Schools]. Available at: https://prjctr.com/mag/aicases (accessed January 9, 2025).

3. Shtuchnyi intelekt [Artificial intelligence]. Available at: https://uk.wikipedia.org/wiki/Штучний_інтелект (accessed January 9, 2025).

4. Nezvychaini fakty pro shtuchnyi intelekt ta robototekhniku – tsikavynky, yaki vas zdyvuiut [Unusual facts about artificial intelligence and robotics – interesting facts that will surprise you]. Available at: https://fact-news.com.ua/nezvichajni-fakti-pro-shtuchnij-intelekt-ta-robototexniku-tsikavinki-yaki-vas-zdivuyut (accessed January 9, 2025).

5. Shtuchnyi intelekt v osviti: try aspekty [Artificial Intelligence in Education: Three Aspects]. Available at: https://osvita.ua/school/method/91077/ (accessed January 9, 2025).

6. Perspektyvy vykorystannia shtuchnoho intelektu v shkilnii osviti [Prospects for the use of artificial intelligence in school education]. Available at: https://naurok.com.ua/post/perspektivi-vikoristannya-shtuchnogo-intelektu-v-shkilniy-osviti (accessed January 9, 2025).

7. Pohorelenko A. (2018) Shtuchnyi intelekt: sutnist, analiz zastosuvannia, perspektyvy rozvytku [Artificial intelligence: essence, application analysis, development prospects]. *Naukovyi visnyk Khersonskoho derzhavnoho universytetu – Scientific Bulletin of Kherson State University*, vol. 32, pp. 22–27. Available at: https://ej.journal.kspu.edu/index.php/ej/article/view/405/401 (accessed January 9, 2025).