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ЕНЕРГЕТИКА
ТРАНСПОРТ АПК



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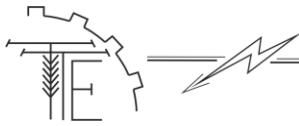
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INTEGRATION OF ARTIFICIAL INTELLIGENCE IN THE EDUCATIONAL PROCESS OF AGRO ENGINEERING STUDENTS

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The article is devoted to the research and analysis of the possibilities and benefits of the integration of artificial intelligence (AI) into the educational process of students specializing in agricultural engineering. The advantages of using AI in the educational sphere and its potential to improve the quality of education and training of future specialists are considered. In particular, attention is focused on improving students' analytical skills through the analysis of large volumes of data, optimization of agricultural processes with the help of machine learning systems, and the development of their innovative skills.

Artificial intelligence - attributes of smart systems that perform innovative functions, traditionally considered a human prerogative; the science and technology of creating intelligent machines, especially intelligent computer programs. Artificial intelligence is concerned with the task of using computers to understand human intelligence, but it is not necessarily limited to biologically feasible methods. The fields of application of modern intelligent systems are very narrow. For example, a program that can beat people at chess and cannot answer questions, etc.

The impact of AI integration on improving student success in education and preparation for the challenges of the modern agricultural sector has been studied. The conclusions of the article indicate the importance of the implementation of artificial intelligence technologies for increasing the efficiency of the educational process and training qualified personnel in the field of agricultural engineering. In addition, the article examines specific examples of the application of artificial intelligence in the educational process of agricultural engineering students, such as systems for analyzing soil and weather conditions, autonomous robots for watering and caring for crops, as well as software tools for predicting yields. Special attention is paid to the practical aspects of the implementation of AI technologies in the educational process, such as teaching methods and assessment of students' educational achievements.

The article also examines potential challenges and obstacles that may arise when integrating artificial intelligence into the education of agricultural engineers, such as the availability of technology, the preparation of teachers and students to use AI, and the ethical aspects of using algorithms and data for educational purposes.

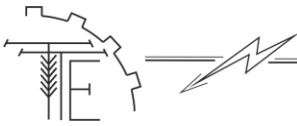
Key words: artificial intelligence, educational process, agricultural engineering, integration, innovation, research, training, efficiency, adaptation, agriculture.

Fig. 1. Table. 2. Ref. 9.

1. Problem formulation

In Ukraine, education reform is currently underway, aimed at creating an innovative educational environment, where pupils and students will be able to develop the key competencies necessary for successful functioning in the modern world, and scientists will have opportunities and resources to conduct research that will affect the socio-economic and innovative development of the country. The digital transformation of education is a key tool of this reform, which at the first stage involves the introduction of modern technologies into the educational process, such as information systems, mobile devices and various gadgets. As part of this process, students can independently or with the help of teachers find the necessary information using a browser interface that does not have automated search elements [1]. This means they have to use trial and error to find the information they need.





Due to the fact that access to various information systems in higher education institutions forces students and teachers to spend a significant amount of time searching for the necessary information, and often does not bring the expected result, there is a need to automate the processes of information collection, the formation of data arrays in information systems and provide convenient access to information for users (students and teachers). Also, it is necessary to provide support to teachers in the process of creating individual educational trajectories. Due to the large amount of data processed in information systems, achieving such goals is possible only if artificial intelligence technologies are used [2].

The purpose of the article is to conduct research and analyze the potential and advantages of integrating artificial intelligence (AI) into the educational process of students specializing in agricultural engineering. The article aims to reveal the possibilities of using AI to optimize training and improve the quality of training of future specialists in the field of agriculture. In addition, the article aims to identify potential challenges and obstacles that may arise during the implementation of AI in the educational process, and to develop recommendations for overcoming them.

2. Analysis of recent research and publications

The latest research in the field of integration of artificial intelligence in the educational process of agricultural engineering students shows the significant potential of this initiative to improve the quality of education and training of future specialists. Research confirms that the use of artificial intelligence allows improving the effectiveness of learning by individualizing and adapting the learning material to the needs of each student [3]. The use of innovative technologies, such as machine learning and data analysis, fosters creativity, problem-solving and other key skills necessary for a successful career in agricultural engineering. It is known that the introduction of artificial intelligence into the educational process can lead to an increase in the success of students due to more effective assimilation of the material and improvement of the quality of educational programs.

Previous research suggests that the use of artificial intelligence in education can be beneficial, but it is worth carefully examining its impact on learning and considering the risks and challenges it may pose. The potential for the application of artificial intelligence in education is very large, and it can help solve many problems faced by modern education systems [4]. However, there are challenges and limitations associated with the development and implementation of reliable and ethical algorithms that allow for security and protection of user privacy. It is necessary to continue research in the field of application of artificial intelligence in education in order to find new opportunities for improving the educational process and increasing the effectiveness of learning.

3. The purpose of the article

The main goal of the article is to research and analyze the possibilities of integrating artificial intelligence into the educational process of agricultural engineering students with the aim of improving the quality of education and training qualified specialists who are able to effectively use the latest technologies in the agricultural sector.

Task of the article:

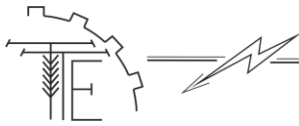
- analysis of the impact of AI on the educational process and its role in the development of students' analytical and innovative skills;
- to analyze how AI technologies can improve the success of students in education and preparation for the challenges of the agricultural sector;
- consider the methods of teaching and evaluating the educational achievements of students using AI.

4. Results of the researches

Artificial intelligence, according to the Concept of the Development of Artificial Intelligence in Ukraine, is an organized set of information technologies that allows you to perform complex tasks using systems of scientific methods and information processing algorithms. The development of these technologies in the educational environment is considered an important direction of modern development. The use of artificial intelligence in the educational environment has significant potential for improving the effectiveness of learning and personalizing the educational process [5].

The main possibilities and prospects of using artificial intelligence in education include:

- Personalization of learning: With the help of artificial intelligence, you can create individual learning programs that take into account the needs and learning style of each student.
- Automatic evaluation of knowledge: artificial intelligence allows to automate the process of evaluating students, which simplifies and accelerates this process.



- Analysis of student behavior: with the help of artificial intelligence, it is possible to analyze the behavior of students on distance learning platforms and provide individual support.
- Use in information systems: artificial intelligence can be used to automate the process of data collection and processing in information systems, which provides fast and accurate access to information.
- Development of individual learning paths: the use of artificial intelligence allows teachers to create personalized learning plans for each student, which helps to better take into account his characteristics and pace of learning, and also ensures effective learning of the material.
- Development of critical thinking: the use of artificial intelligence can promote the development of students' critical thinking and analytical skills through the analysis of various data and information.
- Automating Student Interactions: Artificial intelligence can be used to automate the process of interacting with students, including answering questions, providing support, and organizing collaborative work.

The use of artificial intelligence in the educational environment faces numerous challenges and issues, including the following:

1. Ethical and legal aspects: The development and use of artificial intelligence systems requires the resolution of ethical and legal issues, such as the protection of personal data, responsibility for decisions made, and security issues.

2. Data privacy concerns: The use of artificial intelligence systems requires the collection of large amounts of data, including personal information, which may create data privacy and privacy concerns.

3. The need to develop skills that cannot be replaced by artificial intelligence: Some skills, such as social interaction, collaboration, critical thinking and creativity, are important and cannot be completely replaced by artificial intelligence. Therefore, it is important to develop these skills in students regardless of the application of artificial intelligence technologies.

4. Risks of decreasing the quality of learning and the development of critical thinking: The use of artificial intelligence can lead to a decrease in the quality of learning and the development of critical thinking if pupils and students become passive recipients of information provided by artificial intelligence systems [6].

It is also necessary to develop and implement reliable and ethical algorithms that allow to ensure the security and protection of user privacy. It is necessary to develop technologies that allow interaction with artificial intelligence in an intuitive and accessible way, in particular with the help of interfaces that resemble communication with a living person. It is also important to make AI technologies accessible to different categories of users, including students with different needs and disabilities.

It is necessary to take into account the socio-economic aspects of the introduction of artificial intelligence technologies into the educational process, in particular the costs of development and implementation, the availability of technologies for the general population and the possibility of their integration into national educational systems.

For the successful implementation of artificial intelligence technologies in the educational environment, it is necessary to ensure interaction between technology developers, teachers and students, as well as to involve experts from various fields in this process, in particular, in ethics and legal regulation of the use of artificial intelligence (Table 1).

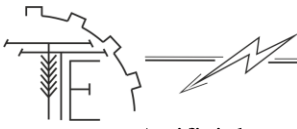
Table 1

Advantages of integrating AI into the educational process of students majoring in Agricultural Engineering

Year	Advantages
2024	Increasing analytical skills through the analysis of large volumes of data on soil, weather, yield, etc.
2025	Optimizing agricultural processes with machine learning systems that help automate and optimize irrigation, harvest operations, plant health monitoring, and more.
2026	Development of innovative skills of students through training using AI, which stimulates them to develop and implement innovative solutions in the field of agricultural engineering.
2027	Preparing students for the modern labor market, where knowledge and skills in the use of AI become an additional asset, as modern enterprises increasingly use artificial intelligence technologies to optimize production processes.

Experts in this field suggest that there are three types of artificial intelligence:

- Artificial intelligence level one (ANI) is a level that focuses on solving problems within one specific field.



- Artificial second-level intelligence (AGI) is artificial intelligence that reaches and exceeds the level of human consciousness. AGI can solve math and logic problems, perform abstract thinking, and analyze and assimilate complex concepts, learn quickly, and gain experience.
- Artificial intelligence of the third level (ASI) is the highest level of development of artificial intelligence, which surpasses the intellectual abilities of all mankind. ASI emerges with development and self-learning that results from repeated experience.

Artificial First Level Intelligence (ANI) is used in various industries such as automotive, energy, financial sector, telecommunications and others. In particular, ANI technology underlies Google's search engine and Facebook's news platform. Modeling the human brain is based on two main assumptions.

Philosopher John Searle proposed the term "powerful artificial intelligence", believing that it should imitate the functions of the human mind, that is, the ability of the human brain. An example of powerful AI is the IBM Watson supercomputer, which has the task of understanding natural language and finding answers in databases. IBM Watson can also recognize human handwriting. Weak artificial intelligence specializes in narrow tasks, such as Deep Blue, a chess supercomputer developed by IBM. Although "Deep Blue" has high expertise in the game of chess, it is significantly different from humans. SwiftKey Keyboard is a smart app that improves typing on your device's on-screen keyboard by offering faster and easier ways. Swiss scientists have developed a search drone that uses two cameras to monitor the environment and analyze 20,000 images to understand a person's route in different places [7].

The term "balance" reflects the simulation of satisfaction and response to the input of information during the process. It depends on the level of excitement. Excitation affects the equilibrium of the process. If the image matches the process, the process returns to equilibrium, and the result is a recognized image. The original image contains identification criteria and attributes of the state of the subprocess, which, for example, reflect the degree of danger of the image to consciousness. This process mimics the function of neurons, as biological cells work until they die. The main functions of the subprocess are recognition and perception of a new image (learning). When an image is classified as new, attention is focused on learning it in a short time, and in some cases long-term memory is required. The process begins in an unbalanced state (dissatisfaction).

The goal is to increase the amount of information in the image to improve recognition accuracy. It can be thought of as a metaphor for perception, hearing, memory, and more. In this case, the sense organs and the body receive commands that change their position in space, which leads to a change in the position of the image in the space of the sensor prescription and a change in the informational nature of the image attributes. It is similar to abstract image processing that activates and connects different long-term memories. Concentration in each simple process illustrates the ability of the human mind to perform different actions simultaneously.

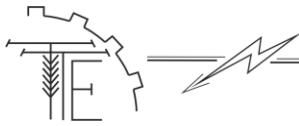
The operation of a subprocess is provided by block and foundation: a method that allows identifying the activity of a process within a limited time and reducing the number of images in the work area of the process. Just as a person can perceive only five (\pm two) objects at a time. This is used for rapid (semi-conscious) recognition and the conversion of recognized images into short-term memory.

The body information movement control unit and the body information movement mechanism are intended to increase the image information of the input information and add additional information from other processes. The sphere of the automated information system represents formal dynamic processes that take place in a priori uncertain conditions.

A less formalized process has the following characteristics:

- the uniqueness of the process associated with mental modeling;
- the decision-making process characteristic of a person;
- the nature of the identification feature can be quantitative or qualitative;
- diversity of the scale of measurement of an identification feature;
- implicit nature of characteristic intellectual property relations;
- multi-level hierarchy of databases and interrelationships of subprocesses;
- sub-processes can interact with each other in different forms, which leads to the heterogeneity of the information flow in the system;
- multifaceted factors and some conflicting standards;
- blurring the compactness of the image due to dynamic arbitrary initial processing conditions at the time of information retrieval.

The active use of systems with elements of artificial intelligence significantly transforms our modern reality and forms a new worldview. Technological equipment that has the functions of artificial intelligence is becoming a necessary component of our daily life, contributing to increased comfort and safety. In the field of artificial intelligence, tasks are already systematized and automated, which makes it perfectly suitable for any



field of human intellectual activity. In this regard, artificial intelligence can be considered as a universal tool in the scientific field [7].

1. Siri, the personal assistant offered by Apple for iPhone and iPad, has become one of the most popular. This friendly female voice assistant interacts with the user in their daily routine, helping to find information, get directions, send messages, make voice calls, open applications and add events to the calendar. Thanks to machine learning technology, it is able to understand natural language and user requests, and it is undoubtedly one of the most significant examples of machine learning capabilities in gadgets.

2. Tesla is not only a car, but also an example of the use of artificial intelligence in the field of motor vehicles. This car is considered to be one of the best in the market, offering features that exceed expectations, such as automatic driving, predictive capabilities and absolute technological innovation. If you've ever dreamed of owning a car from Hollywood movies, then Tesla is just what you need, as it keeps getting smarter with software updates.

3. Cogito, created by Dr. Sandy and Joshua, is recognized as an excellent example of applying the behavioral version to improve the intelligent interaction with help desk customers. This company uses a synthesis of machine learning and behavioral science to increase the effectiveness of communication with customers in the field of telephone service. Cogito has been used successfully in millions of voice calls, providing real-time guidance to improve collaboration.

4. Netflix is a widely popular service that uses predictive technology to make content recommendations based on users' reactions, interests, choices, and behaviors. This technology analyzes viewing history to recommend movies that match the user's previous preferences and reactions. Netflix is getting smarter every year, although one of the downsides is that lesser-known movies can go unnoticed compared to big blockbusters.

5. Pandora is one of the most popular and valuable technological solutions recognized for its uniqueness in the field of music. Based on an analysis of 400 musical characteristics, Pandora's system provides personalized recommendations for songs that match users' unique tastes, even those that may not be noticed on other services.

6. Nest (Google) Nest is one of the most famous and successful startups in the field of artificial intelligence, which was acquired by Google in 2014 for \$3.2 billion. The Nest Learning Thermostat uses behavioral algorithms to effectively manage energy efficiency based on your habits and schedule. It's a very smart machine learning process that automatically adapts to your comfort throughout the week. In addition, it automatically turns off to save energy when no one is home. It is actually a combination of artificial intelligence and Bluetooth low energy, as some components of this solution use BLE services and solutions.

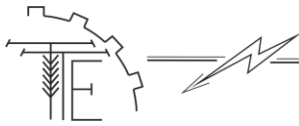
7. Boxever is a company that relies heavily on machine learning to improve the customer experience in the tourism industry and deliver micro-moments or experiences that can make customers happier. Boxever dramatically improves customer engagement by using machine learning and artificial intelligence to manage personalized experiences, helping customers discover new opportunities and create memorable journeys.

8. Flying drones are already successfully delivering goods to customers' doors, even in test mode. They demonstrate a powerful machine learning system that can transform the environment into a 3D model using sensors and video cameras. Sensors and cameras can determine the position of drones in a room fixed to the ceiling. The trajectory generation algorithm determines where and how the drone should move. By using a Wi-Fi system, we can control drones and use them for specific tasks, such as delivering goods, creating videos or reporting news.

9. The Echo, developed by Amazon, is constantly evolving and enriched with new functions. This revolutionary product can be your reliable assistant for searching the Internet, scheduling meetings, shopping, controlling lights, switches, thermostats, answering questions, listening to audio books, getting traffic and weather information, providing information about local businesses, sports scores and schedules, as well as performing many other tasks thanks to the Alexa voice assistant service.

Artificial intelligence is a complex object of study based on the use of a complex combination of computer science, mathematics and other sciences. Sophisticated programming helps these machines reproduce human cognitive abilities [8].

Artificial intelligence helps reduce errors and increase accuracy in various fields, including space exploration. Intelligent robots are sent to explore space equipped with metallic bodies that are durable and able to withstand hostile atmospheres. Artificial intelligence and robotics can be used to extract fuel and explore the ocean floor, overcoming human limitations. These sophisticated machines can perform complex tasks with greater responsibility and efficiency. Artificial intelligence is widely used in various fields, including financial institutions, fraud detection and interaction with users through "avatars". Robots equipped with artificial



intelligence demonstrate logical thinking and are able to perform repetitive tasks faster and more efficiently, without the emotional impact that can affect human performance. They can be used for dangerous tasks by adjusting their parameters such as speed and time. Interactions with artificial intelligence are becoming more common in our daily lives through voice assistants, GPS, financial technology and social media.

In computer games, we face machine intelligence that adapts to our movements and plans its actions accordingly. This is one of the most widespread examples of the use of artificial intelligence. Artificial intelligence is also widely used in medicine. Doctors use AI to assess patients and risks, and to study drug side effects. Artificial surgery simulators train medical professionals, and artificial intelligence is used in the detection and monitoring of neurological disorders. Robotics helps patients with mental illnesses, and radiosurgery is used in operations for operable tumors, avoiding damage to surrounding tissues. Machines work continuously, without the need for frequent breaks and do not get tired, which makes them effective in performing complex tasks.

Disadvantages of artificial intelligence include:

1. High cost: The development of artificial intelligence requires significant costs due to the complexity of these systems. Repair and maintenance of such systems also require large costs. In addition, software needs to be constantly updated to adapt to changes in the environment and to improve its performance.
2. Lack of a human copy: Artificial intelligence remains only a programmed tool without emotions and moral values, incapable of moral judgment or reaction to new, unfamiliar situations.
3. Lack of Experience: AI cannot gain experience the way humans do, which can lead to a loss of effectiveness over time because they cannot change their reactions to change.
4. Lack of creativity: Artificial intelligence lacks the originality and creativity inherent in humans, and is not capable of intuitive abilities and emotional intelligence.
5. Threat of unemployment: The use of artificial intelligence can lead to mass unemployment, which can affect social stability and lead to dependence on machines and loss of human creativity.

Table 2

Impact of AI on Student Success (in percentage)

Year	Impact of AI on Student Success (in percentage)
2024	15% increase in success through data analysis and process optimization.
2025	20% increase in success due to the development of innovative skills and preparation for the use of modern technologies.
2026	25% increase in success due to improving skills in working with machine learning systems and deepening knowledge in the field of agricultural engineering.
2027	30% increase in success rate due to the implementation of training programs that actively use AI for teaching and research.

The use of AI allows students to analyze large volumes of data, which can contribute to better learning and understanding of material, as well as achieving better results in practical classes and tests. Working with AI as part of educational programs, students acquire skills in developing and implementing innovative solutions [9]. This can have a positive effect on their creativity, problem-solving ability and overall performance. The application of machine learning systems and other AI methods can help individualize the learning process, taking into account the needs of each individual student. This contributes to a more effective learning of the material and an increase in success.

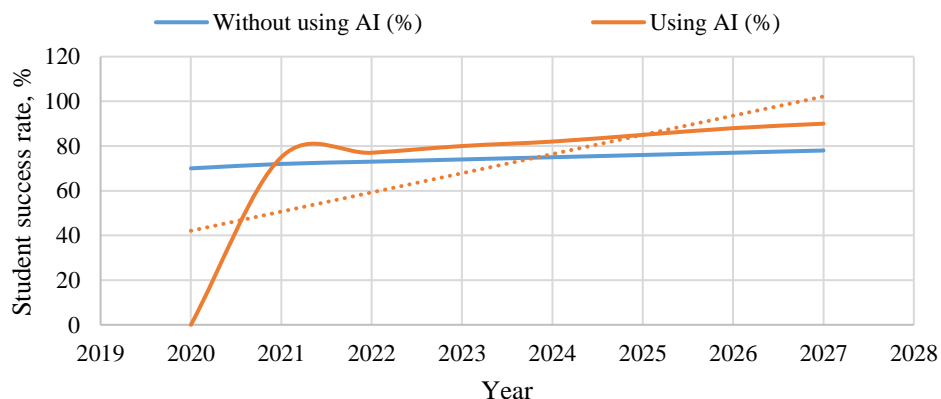
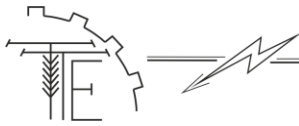


Fig. 1 Performance indicators of students without and with the use of AI



5G and digitization will become engines of technology development and innovation in the field of artificial intelligence. The development of robot technology will have a positive impact on demographics and climate change. The new generation of communications will allow smartphones to process information faster and connect billions of sensors to the Internet, creating the so-called Internet of Things. This will provide a huge amount of data for machine learning systems. The second step is digitization, which means the transition from "analog" to "digital" information systems. The Internet plays a key role in this process, providing access to digital platforms such as the banking sector. Instead of physical credit cards, people can use digital signatures in the browser to make transactions. Digitization also enables the connection of various services and systems, making 5G and digitization key platforms for the introduction of artificial intelligence.

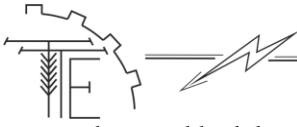
Nowadays, communication service providers are using software for networking (SDN), network functions virtualization (NFV), cloud technologies and 5G technologies to support AI, making them an integral part of their success. A prerequisite for AI success in these industries is the ability to make decisions quickly and efficiently by processing network data in real-time and automating network functions. This allows leading service providers to make changes before problems occur, which is critical to improving efficiency. In addition, AI systems are designed to predict and detect network anomalies or problems, allowing organizations to proactively take steps to correct them before they become apparent to customers. This frees up time for IT teams, allowing them to focus on more important tasks that require human expertise, rather than solving day-to-day problems.

5. Conclusions

1. The implementation of artificial intelligence in the training of agricultural engineers opens up wide opportunities for improving the efficiency and effectiveness of training. Analyzing research results can show what specific benefits students have gained from using artificial intelligence in their learning.
2. The integration of artificial intelligence into the educational process can contribute to improving the quality of education by individualizing educational programs, adapting to the needs of each student, and increasing interest in learning.
3. The use of artificial intelligence in the educational process can contribute to the development of new innovations and technologies in the field of agricultural engineering. This can mean improving agricultural processes, optimizing production and introducing new methods and approaches in agriculture.
4. Although the results of the study indicate the benefits of using artificial intelligence in the education of agricultural engineers, additional research may be necessary to understand the full potential of this integration and to develop strategies for the optimal use of artificial intelligence in the educational process.
5. To successfully integrate artificial intelligence into the educational process, it is necessary to prepare both teachers and students. Teachers must have the appropriate knowledge and skills to use artificial intelligence in the educational process, and students must be prepared to use these technologies in their studies and future careers.

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ІНТЕГРАЦІЯ ШТУЧНОГО ІНТЕЛЕКТУ В НАВЧАЛЬНИЙ ПРОЦЕС СТУДЕНТІВ СПЕЦІАЛЬНОСТІ АГРОІНЖЕНЕРІЯ

Стаття присвячена дослідженню та аналізу можливостей і вигод інтеграції штучного інтелекту (ШІ) в навчальний процес студентів, що спеціалізуються на агроінженерії. Розглянуто переваги використання ШІ в освітній сфері та його потенціал для покращення якості навчання та підготовки майбутніх фахівців. Зокрема, акцентовано увагу на підвищенні аналітичних навичок студентів через аналіз великих обсягів даних, оптимізації процесів сільського господарства за допомогою систем машинного навчання та розвитку їхніх інноваційних навичок.

Штучний інтелект - атрибути розумних систем, які виконують інноваційні функції, традиційно вважаються прерогативою людини; наука і технологія створення інтелектуальних машин, особливо інтелектуальних комп'ютерних програм. Штучний інтелект пов'язаний із завданням використання комп'ютерів для розуміння людського інтелекту, але він не обов'язково обмежується біологічно здійсненними методами. Поля застосування сучасних інтелектуальних систем дуже вузькі. Наприклад, програма, яка може перемогти людей у шахи і не може відповідати на запитання тощо.

Досліджено вплив інтеграції ШІ на підвищення успішності студентів у навчанні та підготовці до викликів сучасного аграрного сектора. Висновки статті вказують на значущість впровадження технологій штучного інтелекту для підвищення ефективності освітнього процесу та підготовки кваліфікованих кадрів у галузі агроінженерії. Додатково, у статті розглядаються конкретні приклади застосування штучного інтелекту в навчальному процесі студентів агроінженерії, такі як системи аналізу ґрунту та погодних умов, автономні роботи для поливу та догляду за культурами, а також програмні засоби для прогнозування врожайності. Особлива увага приділяється практичним аспектам впровадження технологій ШІ в навчальний процес, таким як методи навчання та оцінка навчальних досягнень студентів.

Стаття також розглядає потенційні виклики та перешкоди, які можуть виникнути при інтеграції штучного інтелекту в навчання агроінженерів, такі як доступність технологій, підготовка викладачів та студентів до використання ШІ, а також етичні аспекти використання алгоритмів та даних в освітніх цілях.

Ключові слова: штучний інтелект, навчальний процес, агроінженерія, інтеграція, інновації, дослідження, підготовка, ефективність, адаптація, сільське господарство.

Рис. 1. Табл. 2. Літ. 9.

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