СТРАТЕГІЯ І МЕТОДОЛОГІЯ ОСВІТИ

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METHODOLOGICAL ASPECTS OF USING ARTIFICIAL INTELLIGENCE IN THE FORMATION OF PEDAGOGICAL SKILLS IN THE VOCATIONAL EDUCATION SYSTEM

The article theoretically substantiates the need to reorganize the methodological system for implementing programs based on artificial intelligence in vocational education and identifies the prospects for using the proposed methodology to improve the training of future vocational education specialists in the context of educational transformations. The content of the concept of "artificial intelligence" is defined and its main features and features are revealed. In the context of implementing the methodology, it is recommended to use the following artificial intelligence programs in the field of vocational education: SlideBot, Quizlet, DALL-E, Bard, ChatGPT in the process of studying the discipline "Fundamentals of Artificial Intelligence" in the process of studying the educational and vocational programs "Vocational Education. Technology of Light Industry Products (Sewing Products)" and "015 - Vocational Education. Transport (Technical Maintenance and Repair of Automobiles)". A model for the use of artificial intelligence in vocational education is proposed, which includes the following stages: analysis and definition of needs, development of methodological principles, implementation and piloting, scaling and dissemination, monitoring and evaluation. The presented model is based on three interrelated components of readiness, namely: motivational-target, content-activity and criterion-evaluation. The relevance of the presented methodology was assessed at three levels: high, medium and low. Development prospects include the formation of ethical principles for the use of AI, data protection, improvement of teaching methods, cooperation with IT companies and assessment of the effectiveness of implementation. Promising areas of development are: the formation of ethical principles for the use of AI, ensuring non-discrimination and protection of personal data; research into models of human-AI cooperation; creation of methodological manuals, courses, codes of ethics; establishment of cooperation with IT companies and scientific institutions; systematic assessment of effectiveness and development of communities of practitioners.

KEY WORDS: *neural networks, digital technologies, readiness components, implementation model, electronic services.*

Introduction

Despite the difficult political and economic circumstances caused by Russian armed aggression and the COVID-19 pandemic, Ukraine continues to actively implement electronic government services. In 2021, the Cabinet of Ministers of Ukraine approved a strategic document that defines the directions of development of artificial intelligence (AI) in the country until 2030. This document provides for the active use of AI technologies in education, economy, public administration and other areas to increase Ukraine's competitiveness in the global market. The following year, the Ministry of Education and Science presented an ambitious program «Education 4.0» designed to modernize the education system in accordance with modern challenges and taking into account the recovery plan of Ukraine. This program is part of the national strategy for the development of artificial intelligence [14].

Ukraine is demonstrating significant progress in artificial intelligence research. Scientists from institutions such as the Institute of Cybernetics named after Glushkova, the Institute of Artificial Intelligence Problems, and Taras Shevchenko National University of Kyiv are actively working on the development of new algorithms, models, and applications of AI. Their research covers a wide range of areas and has already yielded a number of important results that have significant potential for the development of Ukrainian science and economy [3; 2].

According to V. Bykov, D. MykulovskyO. Muravchyk, S. Svitsky, and M. Shyshkin, education 4.0 is a new paradigm of education that is designed to prepare people for life and work in the era of digital technologies. It is based on the principles of flexibility, individualization, collaboration, and extended learning. One of the key components of education 4.0 is the use of artificial intelligence. AI systems can analyze data about each vocational education student to create personalized curricula; can automate numerous tasks that are usually performed by teachers, such as assessment, lesson planning and administration. Artificial intelligence programs have the potential to make education more accessible to students around the world; can be used to create simulations and virtual environments that allow students to practice their skills in a safe and realistic environment, as well as to make learning more interesting and exciting for students using games, quizzes and other interactive elements [4].

In his research, S. Chaka (2023) proves that the use of artificial intelligence in vocational education can automate numerous educational processes, opening up new paths for students and facilitating the work of teachers. In order to compensate for the lack of time in the era of Education 4.0, when the world's information base is updated every day at a fairly rapid pace, teachers need to use artificial intelligence programs to make learning more diverse and interesting. This can be done by creating creative tasks of varying levels of complexity. AI is able to generate different task options. Thanks to artificial intelligence, it becomes possible to experiment with different question formats and teaching methods, taking into account the different capabilities and opinions of students. However, it is important to note that many experts believe that the presence of a teacher in the classroom remains irreplaceable. AI can only complement and facilitate the work of a teacher, but not completely replace him.

The world of work is changing rapidly due to technological progress, and vocational education must keep pace with these changes. In numerous scientific works, C. S. González-González, J. Muñoz-Arteaga, C. A. Collazos argue that AI offers many opportunities to improve vocational education and train future professionals in this field who meet the needs of the modern labor market. The researchers identified the main key arguments in favor of using AI in vocational education: personalization of learning, improvement of practical skills, increasing accessibility of education, preparation for working with artificial intelligence, improving the effectiveness of teachers. It is proven that the use of artificial intelligence in vocational education also has certain challenges, such as the potential bias of artificial intelligence systems, the need to ensure cybersecurity and data privacy, as well as ethical considerations regarding the use of artificial intelligence in education. However, the benefits of using artificial intelligence in vocational education far outweigh the risks. AI has the potential to revolutionize vocational education, making it

more personalized, accessible, effective, and relevant to the needs of the modern labor market. It is important to note that AI should not replace teachers, but complement their work. Teachers play an important role in ensuring that students receive high-quality vocational education based on the use of digital educational resources [11].

The purpose of the study was to comprehensively study, evaluate, and improve the process of applying artificial intelligence systems in the professional training of future vocational education specialists.

Taking into account the above statements, the objectives of the study are as follows:

1. To investigate the methodological foundations of the application of artificial intelligence systems in vocational education in higher education institutions of Ukraine.

2. Identify readiness components and develop a model for the successful implementation of the process of effective implementation of artificial intelligence programs in vocational education.

3. Identify methodological tools aimed at improving the process of using artificial intelligence in vocational education.

Methodology

As part of the experimental study, the methodology for using artificial intelligence in vocational education was implemented. The methodology included the development of a model for training future specialists in the field of vocational education and the selection of readiness components for the implementation of the outlined model, namely: motivational, content-technological and criterion-evaluation. Also, as part of the study, a selection of methods was carried out to check the formation of readiness components at the ascertaining and formative stages of the experiment.

The study was conducted during the 2023-2024 academic years and was carried out at Khmelnytskyi National University (Khmelnytskyi National University, 2024). The sample consisted of 42 respondents studying at the Humanitarian and Pedagogical Faculty at the Department of Technological and Vocational Education and Decorative Arts in the Educational and Professional Program «Professional Education. Technology of light industry products (Sewing products) » and «015 – Vocational education. Transport (Car maintenance and repair) ». The control group included 20 higher education applicants, and the experimental group included 22 participants.

It is recommended to implement the motivational component of readiness by implementing project activities (involving students in creating their own projects that allow them to apply the knowledge gained in practice); involving respondents in group work (creating conditions for cooperation and mutual assistance between students); contests and competitions (organizing educational competitions and contests to increase motivation); mentoring (collaboration with more experienced students or teachers). To implement the content-technological component of readiness, the discipline «Fundamentals of Artificial Intelligence» was introduced into the educational process of training vocational education applicants in the context of studying the educational and professional programs «Professional education. Technology of light industry products (Sewing products)» and «015 - Vocational education. Transport (Car maintenance and repair)».

The purpose of the academic discipline «Fundamentals of artificial intelligence» is to form in students systemic knowledge about the principles of design and development of intelligent systems that are capable of learning, reasoning and making decisions in conditions of incomplete information. As part of the course, students are introduced to classical methods of artificial intelligence, modern approaches to knowledge representation and machine learning, as well as current problems and prospects for the development of the industry. The implementation of the criterion-based evaluation component was carried out by developing an evaluation scale that took into account the theoretical knowledge and practical skills of students in using artificial intelligence systems; conducting regular reports, where the effectiveness of task performance was assessed.

To assess the theoretical knowledge and practical skills of students in using artificial intelligence systems according to the criterion-based evaluation component, a four-point evaluation scale was developed, which took

into account the following criteria: depth of theoretical knowledge, ability to apply knowledge in practice, creativity, ability to self-study and adherence to ethical norms. Regularly, monthly, reports were made in the form of presentations, during which students presented the results of their work. The assessment was carried out using rubrics that took into account the correspondence of the work to the tasks set, the quality of design, originality of the approach and compliance with deadlines.

At the ascertaining stage of the experiment, an anonymous survey was conducted among respondents from the control and experimental groups. The questionnaire contained 8 questions related to the methodology of using artificial intelligence in

education. The questionnaire included the following questions: Are you familiar with the artificial intelligence programs SlideBot, Quizlet, DALL-E, Bard, ChatGPT. Do you use the ChatGPT program to complete assignments in academic disciplines? Does the use of AI programs affect the use of plagiarism in papers? Indicate the role of using artificial intelligence systems in professional education. Is there a need for universities to develop rules for using artificial intelligence in the educational process.

After the introduction of the model for implementing artificial intelligence in professional education, repeated testing of respondents from the control and experimental groups who studied using the experimental method was conducted.

Research results

The concept of «artificial intelligence» within the framework of the study refers to a powerful area of computer science with great potential, which seeks to create intelligent agents that can reason, learn and act autonomously. Artificial intelligence systems are able to process large amounts of data, detect patterns in them, make predictions and make decisions, similar to how people do it [30].

The rapid development of artificial intelligence demonstrates its enormous potential. AI is increasingly used to analyze data, automate routine tasks and develop innovative solutions, demonstrating significant potential. Its advantages, such as the ability to replace humans in routine tasks, increase productivity and make effective decisions, are becoming increasingly obvious. Artificial intelligence algorithms are able to process data sets inaccessible to human perception [24; 18].

Modern vocational education in Ukraine is increasingly faced with the problem of ensuring a continuous educational process in conditions of unstable power supply. The use of artificial intelligence and cloud technologies can be an effective solution. They allow you to diversify learning by creating interactive materials and personalizing the educational process, improve access to knowledge by giving students the opportunity to independently study complex topics using AI tools, and increase learning efficiency by automating routine tasks [15; 19].

AI undoubtedly affects the pace, forms

and results of scientific progress in the field of vocational education. With the help of artificial intelligence programs, it is possible to automate routine tasks, such as collecting, cleaning and analyzing data, freeing up time for creative and analytical work; to identify hidden patterns and connections in data that people might miss; to minimize human error and bias, making research more reliable; to integrate data from different sources, which stimulates cooperation between scientists from different fields.

However, the introduction of artificial intelligence into vocational education is associated with a number of challenges, namely: the risk of a digital divide and the need to adapt to new working conditions. For the successful implementation of artificial intelligence in vocational education, it is necessary to ensure access to retraining programs for teachers, develop research in the field of artificial intelligence by stimulating scientific developments in Ukraine, and create a favorable environment for innovation by involving business in cooperation with education.

However, in addition to the advantages, the use of artificial intelligence programs also has disadvantages that cannot be ignored. In particular, there is a risk of establishing total control over people and collecting a huge amount of personal data, which can lead to the restriction of personal freedom [21]. Artificial intelligence algorithms can be complex and opaque, which makes it difficult to understand

how they make decisions. This can lead to distrust of research results and ethical issues related to bias and discrimination. Using artificial intelligence, it is possible to automate many tasks that were previously performed by specialists. This can lead to job losses and the degradation of scientific skills. AI can be used to personalize learning, adapt educational programs to the needs of higher education students, and automate assessment. However, this can lead to the standardization of education and a decrease in the role of teachers [20].

However, given the rapid development of technologies, there is reason to believe that in the future the active implementation of AI will be able to overcome the existing shortcomings. Thanks to a smart combination of artificial intelligence, the human factor, state control and a qualitatively developed methodological system for the use of artificial intelligence in vocational education, it will be possible to create an effective and safe system of vocational training in higher education institutions in Ukraine based on digitalization. It is important that the use of artificial intelligence in vocational education is carried out ethically and responsibly, taking into account all possible risks and benefits. It is necessary to develop clear ethical principles and standards that will regulate its use in scientific research and educational activities. The use of artificial intelligence in the educational process causes ambiguous assessments from the point of view of academic integrity. On the one hand, there is a risk of plagiarism and other violations, because artificial intelligence programs can be used to generate texts, translate languages, and perform tasks without a deep understanding of the material. On the other hand, artificial intelligence can become a tool for better understanding and assessing the knowledge of education seekers, as well as for personalizing learning.

It is important to note that the ethical and responsible use of AI programs is a key factor in maintaining academic integrity. Educators need to clearly outline the rules and expectations for the use of AI in the educational process, as well as teach students the ethical principles of working with this technology [25; 28].

AI systems and professional education are becoming increasingly inseparable.

Professional education students are already actively using AI systems to search for information, complete homework assignments, and prepare for exams. It is important for educators to understand and use AI to improve the educational process, making it more dynamic, interactive, and personalized AI can help educators: automate routine tasks such as checking work and assessing knowledge, create individual learning plans for each vocational education student and provide them with access to additional learning resources and tools, evaluate the effectiveness of learning and make necessary adjustments. Neural networks are complex machine learning algorithms that can simulate the work of the human brain. They are able to learn from data and make predictions, which makes them a valuable tool for vocational education.

In vocational education, neural networks can be used to: recognize speech and visual images, personalize learning and adapt it to the needs of each vocational education student, automatically assess knowledge and provide feedback, create interactive learning environments [22].

Ukrainian society is still getting used to these new directions, so it is important to have a constructive dialogue about their ethical and legal aspects. AI has significant potential to transform education, making it more dynamic, interactive and personalized. It is important to use artificial intelligence ethically and responsibly. In Ukraine, artificial intelligence systems in vocational education and academic integrity are new concepts that have been actively developing over the past decades [10].

Modern artificial intelligence technologies offer a wide range of tools that can significantly facilitate the work of teachers and make vocational education more effective. The following artificial intelligence programs have been proposed for use in the field of vocational education.

SlideBot – automatic creation of presentations based on entered text. This tool saves time on preparation, allowing the teacher to focus on teaching methods. SlideBot also offers an optimal slide structure for better assimilation of the material by vocational education students.

Quizlet – creation of cards with questions and answers, automatic generation of tests, interactive games, automatic checking of answers, analysis of results, recommendations

for further learning. Quizlet helps the teacher to better understand the needs of vocational education students and offers an individual approach to learning.

DALL-E – creation of images and videos based on text description. DALL-E allows you to visualize historical events, generate videos with audio description, make learning more exciting and promote deeper immersion of students in the material [23; 26].

The introduction of artificial intelligence into the educational process of vocational education can significantly increase its efficiency and quality by reducing preparation time, automating routine tasks, saving resources, using an individual approach to learning, adapting to the needs of each vocational education student, differentiating tasks, increasing motivation and interest in the subject, deeper immersion in the material, using interactive and exciting learning formats, collecting data on learning outcomes, identifying topics that require additional study, and monitoring the progress of vocational education students [13].

For the effective introduction of artificial intelligence into vocational education, it is necessary to clearly identify priority areas for its application. Analysis of successful cases will help to form recommendations for the development and implementation of new AI solutions that will be most relevant for Ukrainian vocational education institutions.

AI has significant potential to revolutionize scientific research and the educational process. However, it is important to be aware of the ethical dilemmas associated with its use and take steps to address them. Only with an ethical and responsible approach can artificial intelligence become a truly valuable tool for the development of professional education.

The methodology for introducing artificial intelligence into the field of vocational education opens up new opportunities for improving the quality of education, personalizing the educational process and training specialists who meet the challenges of the modern labor market. However, for the effective use of artificial intelligence in this area, a clear methodology is needed that takes into account the specifics of vocational education and the needs of its participants.

In the process of conducting an experimental study, the methodology for using artificial intelligence in vocational education was implemented. The outlined methodology consists of the following components.

1. Analysis of needs and opportunities. Assessment of current processes (detailed analysis of existing curricula, assessment methods, infrastructure and resources). Identification of problem areas (identification of areas where AI can bring the greatest benefit, for example, personalization of learning, automation of routine tasks, analysis of large volumes of data). Assessment of technical readiness (analysis of the availability of the necessary equipment, software and infrastructure to support AI systems).

2. Development of an implementation strategy. Definition of goals (clear formulation of the expected results from the implementation of AI, for example, improving the quality of learning, increasing student motivation, optimizing the work of teachers). Selection of AI tools (research and selection of appropriate AI tools that meet the needs of the educational institution). Creation of a roadmap (development of a detailed implementation plan, including stages, deadlines, responsible persons and necessary resources).

3. Training of pedagogical personnel. Teacher training (conducting trainings and seminars to familiarize teachers with the capabilities of AI and providing them with skills to work with new technologies). Changing the role of the teacher (rethinking the role of the teacher in the context of using AI, focusing on the development of creative and communicative skills). Creating a community of practitioners (forming a community of teachers to exchange experience and support each other).

4. Building infrastructure. Technical support: Ensuring the availability of the necessary equipment (computers, network, software) for the operation of AI systems. Data protection (implementing measures to ensure the security and confidentiality of student data). Systems integration (integrating AI systems with existing information systems of an educational institution).

5. Phased implementation and evaluation. Phased implementation (starting with small projects and gradually expanding the scope of AI applications). Collecting feedback (obtaining feedback from students, teachers, and administration on the

effectiveness of the implemented AI tools). Monitoring and evaluation (regular monitoring of implementation results and making necessary adjustments).

6. Continuous development. Technology updates (monitoring the latest achievements in the field of AI and timely updating of the tools used). User support (providing users with ongoing support and assistance in solving problems). Curriculum improvement (constantly updating curricula to take into account new AI capabilities).

Key aspects of successful implementation of the methodology in vocational education are taking into account the specifics of each educational institution and the needs of its students. Involvement of all stakeholders in the implementation process (teachers, students, administration, parents). Phased implementation of AI to avoid system overload. Regular evaluation of implementation results and making necessary adjustments. Providing ongoing support to users and teachers.

Taking into account the outlined components of the model, a survey was conducted at the ascertaining stage of the experiment, the results of which determined that 82% of respondents are familiar with artificial intelligence programs SlideBot, Quizlet, DALL-E, Bard, ChatGPT, 43% of respondents used ChatGPT to complete assignments in academic disciplines, 78% of respondents understand that the use of artificial intelligence systems can lead to plagiarism, 14% of respondents admitted that they used artificial intelligence systems to complete assignments, passing off the result as their own, 52% of respondents believe that the use of artificial intelligence systems in professional training can be useful if it is used ethically, 87% of respondents believe that universities need to clearly define the rules for using artificial intelligence in the educational process. Thus, the conclusions were drawn that vocational education students, in general, have a positive attitude towards the use of artificial intelligence programs in education and use them.

To determine the levels of readiness of higher education students to use artificial intelligence in professional education at the stage of the ascertaining experiment, a model was built based on which three components were distinguished: motivational-target, content-technological, and effective. The motivational-target component provides a methodological basis for the use of artificial intelligence in professional education. The purpose of creating the model was the need to improve the methodological component of the use of artificial intelligence in professional education; motivation of vocational education students to use artificial intelligence in their professional activities. The following approaches were taken as a basis: systemic, personality-oriented, activity-based, conceptual, and multi-subject. The following principles were used in the work: clarity (use of visual materials, such as pictures, diagrams, tables, for better understanding and assimilation of information); nature-conformity; activity (stimulating the active participation of vocational education students in the educational process, using interactive teaching methods and artificial intelligence); systematicity and consistency (ensuring a logical connection between topics and classes, gradual complication of educational material); perspective and continuity (taking into account the prospects for the development of students' knowledge and skills, ensuring a connection between the previous and subsequent educational material); humanization (creating an atmosphere of trust and cooperation, respect for the student's personality, his thoughts and feelings).

In the context of the formation of the cognitive-activity component of readiness, there is knowledge of the methodology and the ability to apply artificial intelligence systems in vocational education. For this purpose, a methodology for using artificial intelligence in vocational education was developed. Software based on artificial intelligence was selected and a methodology for their use was presented. Learning outcomes were regularly assessed in order to make the necessary adjustments.

The performance-evaluation component in the context of the digital transformation of education plays a key role, as it allows assessing the effectiveness of using artificial intelligence systems in the educational process. The outlined component helps to adapt the educational process to the requirements of modernity and ensure high-quality preparation of vocational education applicants for life in a digital society.

The results of the formation of the readiness components at the ascertaining stage

of the experiment are presented in Figure 1.
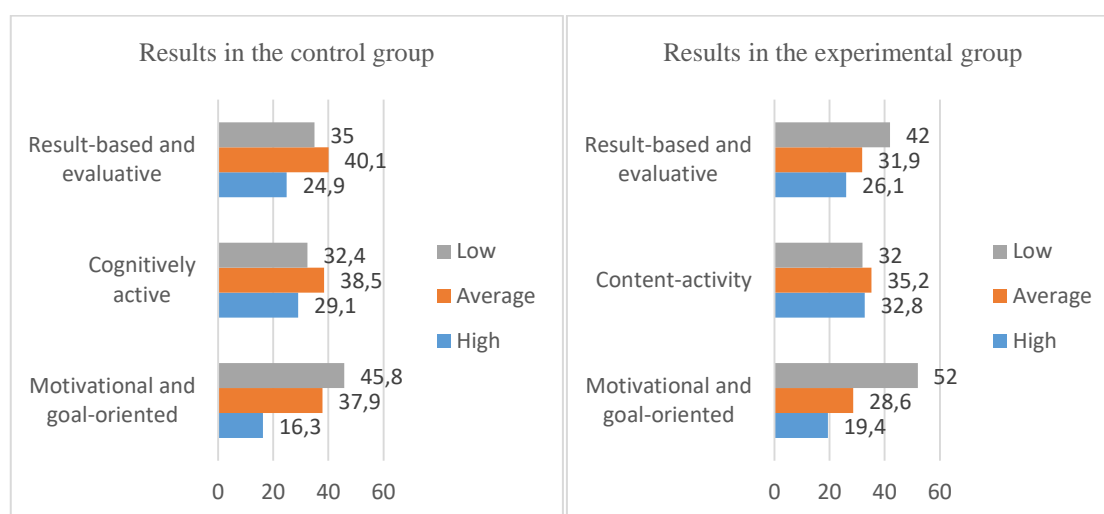
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Fig. 1 – Results of the assessment of the development of professional competencies using the updated methodology for using artificial intelligence in vocational education in the control and experimental groups at the stage of the ascertaining experiment

Considering the obtained research results, there is a need to develop clear rules for using artificial intelligence in vocational education, including the definition of permissible and unacceptable practices; conduct training in conversations for education seekers on the ethical use of artificial intelligence systems and academic integrity; offer education seekers alternative methods and tools for performing tasks that do not require the use of artificial intelligence; develop a model of the updated methodology for using artificial intelligence in vocational education, conduct further research on the impact of artificial intelligence on the educational process of vocational education and academic integrity.

The results of the study at the ascertaining stage of the experiment showed that respondents from both the control and experimental groups have a low and medium level of motivation to use artificial intelligence systems in their professional activities. This indicates their unwillingness to develop in a professional direction. The insufficient level of formation of the cognitive-activity component also emphasizes the need to update the methodological system for using artificial intelligence in vocational education. The conceptual-target component of readiness needs improvement. This is due to the fact that it is important to be able to evaluate one's

achievements and knowledge in this area. Thus, there was a need to conduct a formative stage of the experiment. Its goal was: to introduce a methodological system for using artificial intelligence in vocational education into the educational process. This methodology is an author's model of professional training of future teachers of vocational education with technologies for forming its components. In the control group, classes were conducted according to the traditional methodology, and in the experimental group - according to the proposed methodology, using digital educational resources based on artificial intelligence.

The proposed model includes the following stages. Analysis and definition of needs (conducting a comprehensive study of the needs and expectations of vocational education stakeholders (teachers, students, employers, government agencies, etc.), identification of key competencies and skills that should be formed in students as part of vocational training, analysis of available resources and infrastructure for the implementation of artificial intelligence in vocational education). Development of methodological principles (definition of methodological principles for the use of artificial intelligence in vocational education, taking into account ethical norms, principles of accessibility and inclusivity, development of

methodological recommendations for the selection and integration of artificial intelligence tools in vocational education; creation of curricula and courses for training teachers to use artificial intelligence in vocational education). Implementation and piloting (development and implementation of pilot projects on the use of artificial intelligence in vocational education in different fields and at different levels of training, assessment of the effectiveness of the use of artificial intelligence tools and their impact on student learning outcomes, adjustment of methodological principles and recommendations based on the results of the pilot implementation). Scaling and dissemination (development of a strategy for scaling the use of artificial intelligence in vocational education at the national and regional levels, creation of platforms and resources to support teachers and students in the use of artificial intelligence, ensuring cooperation with government agencies, employers and other stakeholders to promote the use of artificial intelligence in vocational education). Monitoring and evaluation (ensuring continuous monitoring and evaluation of the effectiveness of the use of artificial intelligence in vocational education, collection and analysis of data on the impact of artificial intelligence on learning outcomes, student motivation, teacher and employer satisfaction, making changes to the methodology and practice of using artificial intelligence based on the results of monitoring and evaluation).

The implementation of this model of improving the methodological aspects of the use of artificial intelligence in vocational education expects: improving the quality and efficiency of vocational training, personalizing the educational process and adapting to the individual needs of students, developing new competencies and skills in students that meet the challenges of the modern labor market, increasing the motivation and involvement of students in learning, improving cooperation between teachers, students, employers and government agencies.

The use of AI has significant potential for transforming vocational education and training specialists who meet the needs of the modern economy. The proposed model of improving the methodological aspects of the use of artificial intelligence can serve as a

guideline for the development and implementation of effective strategies for using artificial intelligence in this area.

AI is flowing into education, transforming it into an individual and adaptive process. E-learning platforms such as Enlearn use machine learning to create personalized curricula that meet the unique needs of each student. This approach not only accelerates the acquisition of knowledge, but also makes learning more interesting and effective (Khan; Lulwani, 2023).

Learning management systems (LMS) play a key role in this transformation. They not only centralize learning processes, but also facilitate collaboration between teachers and students. Thanks to LMS, organizations can create flexible and dynamic learning environments that meet modern requirements. AI transforms e-learning from passive content consumption to an active process of interaction. For Generation Z, which strives for self-development and continuous learning, AI opens up new opportunities to achieve their goals.

Systems like ALEKS adapt learning to the needs of each vocational education seeker, analyzing his knowledge and offering personalized tasks. The uniqueness of ALEKS lies in the fact that it does not just provide learning materials, but creates an individual learning path for each vocational education seeker. The system first assesses the student's level of knowledge, and then builds a personalized plan that helps him focus on important topics and consolidate new material.

AI is used in education for various purposes: from creating individual curricula (as in ALEKS and Squirrel AI) to automating routine tasks, such as checking homework (Holmes, Porayska-Pomsta, Holstein, Sutherland, Baker, Shum, Santos, Rodrigo, Cukurova, Bittencourt, Koedinger, 2022).

Thus, after conducting the ascertaining stage of the experiment, information was obtained about the initial state of the use of artificial intelligence systems in the process of training vocational education applicants, artificial intelligence programs were studied and the methodology for their use was outlined, and an experimental updated methodological system for the use of artificial intelligence in vocational education was developed and implemented. The updated methodology was tested by assessing the

formation of the outlined components of readiness for the use of artificial intelligence systems among vocational education students.

The results of the distribution of respondents by levels at the stage of the formative experiment are presented in Figure 2.
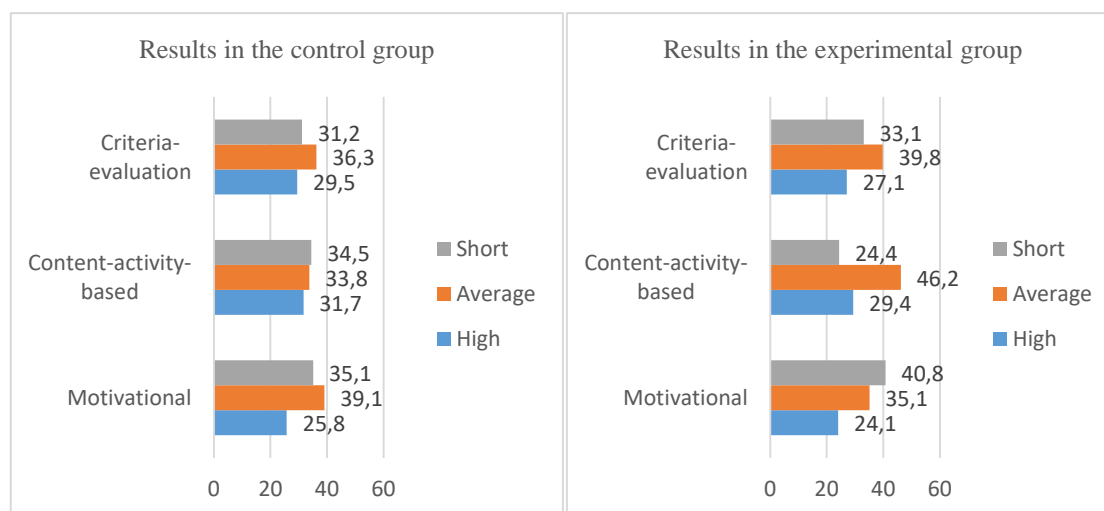
Source: created by the author

Fig. 2 – Results of assessing the development of professional competencies using the updated methodology for using artificial intelligence in vocational education in the control and experimental groups at the stage of the formative experiment

Based on the obtained research results, it was found that the updated methodology for using artificial intelligence in vocational education makes sense, since in the experimental group at the formative stage of the experiment the indicators increased to an average and high level compared to the data obtained at the ascertaining stage of the experiment.

It was determined that students in the experimental group showed greater motivation to use artificial intelligence in their educational activities. Factor analysis allowed us to identify three main factors that influence students' readiness to use AI: motivation, digital competence, attitude towards technology. The results of the regression analysis showed that the level of digital competence is the strongest predictor of students' readiness to use artificial intelligence.

Analysis of the survey results showed that students in the experimental group who participated in educational activities using SlideBot, Quizlet, DALL-E, Bard, ChatGPT demonstrate a significantly higher level of knowledge about the principles of artificial intelligence and the possibilities of its application in the educational process compared to students in the control group.

The use of artificial intelligence in scientific research opens up new opportunities for improving the efficiency and quality of work. However, to ensure academic integrity, clear rules must be followed. Plagiarism, data falsification, and the use of AI for the mass production of low-quality publications are unacceptable. Each researcher must independently analyze the results obtained using AI, and ensure correct citation of all sources used, including data and AI algorithms. In addition, it is important to consider the potential risks associated with algorithm bias and data privacy protection.

Thus, artificial intelligence is closely related to open science through work with big data. It organizes information, analyzes it, and facilitates further research. In education, artificial intelligence can be a teacher's assistant, creating personalized learning. However, there are risks: reducing the role of the teacher, reducing the creativity of vocational education students, and deepening the digital divide.

AI opens up new horizons in education and scientific research. In the training of future professionals in the field of vocational education, artificial intelligence systems can personalize learning, providing an individual approach to each student. In science, artificial intelligence automates routine tasks, analyzes

large data sets, and helps generate new hypotheses. However, it is important to understand that artificial intelligence does not replace human intelligence, but is its powerful tool. For the effective use of artificial intelligence, it is necessary to develop ethical standards and take into account potential risks, such as reducing the role of the teacher in education and possible biases in artificial intelligence algorithms.

AI has the potential to revolutionize education by making it more personalized, effective, and accessible. However, it is important to understand that AI does not replace the teacher, but is a powerful tool for him. The key to successfully using AI in education lies in the intelligent combination of technology and the human factor.

Discussion

Ukraine aspires to become a leader in the field of artificial intelligence. To achieve this goal, a large-scale strategy has been developed for 8 (2023–2030) years. It provides for the phased implementation of measures under the control of the government. The legal basis of the strategy is provided by the country's Basic Law and a number of specialized laws. This document will serve as a roadmap for the development of AI in Ukraine, as it will be used to develop state programs and adopt new laws [5].

The above document justifies the need for urgent transformation of educational programs in Ukraine in order to train highly qualified specialists in the field of artificial intelligence. According to the presented strategy, it is planned to introduce elements of artificial intelligence into the school curriculum and educational programs of higher education institutions in order to form basic knowledge and interest in this field among young people. The creation of specialized bachelor's, master's and doctoral programs focused on training researchers and engineers in the field of artificial intelligence is a modern requirement. There is a need to develop online courses, mobile applications and other interactive tools for distance learning and advanced training, to intensify the interaction of universities with IT companies to develop joint curricula, conduct internships and create research laboratories. Inviting leading world experts in the field of AI to conduct lectures, seminars and joint scientific research. Ensuring stable financing of scientific projects in the field of AI from the budget and through private investments [8].

The expected results include increasing Ukraine's competitiveness in the global technology market, creating new jobs in high-tech industries, accelerating the development of the innovative economy, and strengthening the country's scientific potential. Key advantages of the proposed strategy: coverage of all levels of education from school to postgraduate studies, emphasis on obtaining practical skills and implementing innovations, combining the efforts of specialists from different fields of knowledge, including Ukraine in the international scientific and educational space. Implementation of the proposed strategy will allow Ukraine not only to catch up with world leaders in the field of artificial intelligence, but also to become one of the centers of global innovation [29].

Investigating the issue of using artificial intelligence in education, I. García-Martínez, J. M. Fernández-Batanero, J. Fernández-Cerero, S. P. León revealed the key characteristics of artificial intelligence. In particular, the researchers' opinion on the need to introduce artificial intelligence into the educational process of training vocational education applicants as a requirement of the digital society is continued. The use of the outlined approach is considered appropriate because artificial intelligence systems use complex algorithms to analyze and interpret data from various sources, such as texts, images, audio, and sensory data. They are able to learn from their own experience and improve their work over time. This can be done through machine learning, which involves automatically detecting patterns in data without explicit programming. Artificial intelligence systems can make autonomous decisions based on the data they analyze and the knowledge they have accumulated. They can perform various tasks, such as image recognition, machine translation, text generation, planning, and navigation [9].

S. Z. Salas-Pilco, Y. Yang actively studied the methodology for implementing artificial intelligence in the training of future specialists. Researchers have identified the

following types of artificial intelligence: narrow (focused on performing one specific task or set of tasks, for example, face recognition or playing chess); general (possesses general cognitive abilities); superintelligence (surpasses human intelligence in all aspects). The use of the outlined approach is considered appropriate, since the types outlined by the researchers were used in the process of developing a methodological system of artificial intelligence. It is proven that the implementation of the developed methodology is quite relevant, since in the near future the emergence of «digital universities» based on virtual reality and artificial intelligence is predicted. This indicates the active implementation of digital technologies in the transformation of the educational process. However, given the problems with material and technical support, the primary task is to transform the education system precisely to overcome these problems. For this purpose, a variety of educational resources and digital platforms are being created to support educational content, as well as to create it [27].

The study by O. Yara, A. Brazheyev, L. Golovko, V. Bashkatova is based on the concept of adaptive learning, which involves the constant modification of the educational process in accordance with the individual achievements of higher education students. Analyzing the results obtained during the study, it is clear that the next stage of development of the application of machine learning algorithms allows AI systems to analyze large volumes, identify patterns and predict the further development of each higher education student. The authors of the study demonstrate that artificial intelligence in vocational education can not only automate routine tasks of a teacher, but also contribute to a deeper understanding of the educational process [31].

For example, H.-C. Chu, G.-H. Hwang, Y.-F. Tu, K.-H. Yang in his numerous studies indicated that the readiness of higher education students to effectively use artificial intelligence is a complex phenomenon that includes not only technical skills, but also understanding, attitude and willingness to adapt to the changes that the development of artificial intelligence brings. The researchers continued their opinion and the main components of readiness are divided into the following groups. Technical

skills include understanding the basic principles of artificial neural networks, machine learning, deep learning and other key concepts, the ability to work with programming languages used to develop AI models (Python, R, Java, etc.), the ability to work with various tools and platforms for creating, training and deploying AI models (TensorFlow, PyTorch, Google Colab), the ability to collect, clean, process and analyze data for training AI models. Digital literacy includes knowledge of modern digital technologies and their application in various fields of activity, confident use of a computer, the Internet and various software products, the ability to critically evaluate information obtained from different sources and detect fakes. Soft skills consist of the ability to generate new ideas and non-standard solutions, the ability to analyze information, identify errors and make informed decisions, effectively communicate with people, work in a team and present the results of one's work, understanding the ethical aspects of using artificial intelligence and responsibility for the consequences of one's actions. Understanding the potential and limitations of artificial intelligence: knowledge of the potential negative consequences of using AI (for example, job loss, algorithm bias), the ability to assess the quality of the work of an AI model and identify its shortcomings. Willingness to cooperate with artificial intelligence lies in the understanding that artificial intelligence is a tool that helps a person, not replaces him, and the ability to adapt to new ways of working that arise due to the use of AI. The development of these components in higher education students is an important task for universities and educational institutions [7].

This will allow preparing specialists in the field of vocational education who will be able to effectively use artificial intelligence to solve complex problems and contribute to the development of an innovative economy. K. Alhumaid, S. Naqbi, D. Elsori, M. Mansoori believe that in modern conditions there are several models that try to describe the future development of artificial intelligence. Some of them are: exponential development: (assumes that the development of AI will occur exponentially, i.e. faster and faster); S-curve (assumes that the development of AI will occur along an S-shaped curve, i.e. first slowly, then

quickly, and then slowly again); technological singularity model (assumes that in the future AI will surpass human intelligence and lead to radical changes in society). The use of the outlined approach is considered appropriate, as the outlined models are reflected in the presented study of methodological aspects of the use of artificial intelligence in vocational education [1].

Thus, the application of artificial intelligence in vocational education has a number of advantages. Artificial intelligence systems allow for the creation of personalized curricula that meet the needs and learning style of each higher education student, can automate many tasks, freeing up teachers' time for more creative work with higher education students, artificial intelligence can make education more accessible to students with different abilities. AI is becoming an increasingly powerful tool for improving education. Due to its capabilities for personalization, automation and accessibility, artificial intelligence has the potential to revolutionize this field.

Conclusions

Artificial intelligence is increasingly integrated into the educational process, offering new opportunities for personalizing learning and automating routine tasks. At the same time, the widespread use of AI raises concerns about its impact on the role of the teacher, the development of creativity of vocational education students and the deepening of the digital divide. The study proved that ensuring high-quality implementation of professional training of vocational education applicants in higher education institutions of Ukraine should be based on a high-quality methodology for organizing work with artificial intelligence programs.

It was determined that artificial intelligence is becoming a driving force of global changes. Its influence is felt in all spheres of life, from economy to culture. The content of the concept of "artificial intelligence" is determined and its features and features are revealed. This work presents a model and an updated methodology as a component of the model for the successful implementation of the introduction of artificial intelligence systems in the training of specialists in the field of vocational education. A model for the successful implementation of the methodology for using artificial intelligence in the process of professional training of future specialists has been developed, which includes three interrelated components: motivational-targeted, content-

activity, and criterion-evaluation.

The conducted analysis of scientific literature allowed to systematize the idea of the application of artificial intelligence systems in professional education and to determine the main ways to solve this problem in the training of future specialists. An innovative model was developed, which provided for the structuring of the educational process according to three main components: motivational, content-technological and criterion-evaluation. To empirically verify the effectiveness of the proposed model, ascertaining and formative experiments were conducted, during which appropriate diagnostic methods were used.

Promising areas of use of artificial intelligence in the educational process are ethical aspects of using AI in education (development of ethical principles for using AI in education, ensuring fairness and preventing discrimination); data protection (development of effective methods for protecting students' personal data used by AI systems); cooperation between humans and artificial intelligence (research of optimal models of interaction between humans and AI in the educational process); development of detailed methodological manuals and instructions, creation of specialized courses and trainings, development of university standards and codes of ethics, cooperation with IT companies and scientific institutions, systematic assessment of effectiveness, creation of a community of practitioners.

Conflict of interest

The author declares that there is no conflict of interest regarding the publication of this manuscript. Furthermore, the author has fully adhered to ethical standards, including those related to plagiarism, data falsification, and duplicate publication.

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МЕТОДОЛОГІЧНІ АСПЕКТИ ВИКОРИСТАННЯ ШТУЧНОГО ІНТЕЛЕКТУ У ФОРМУВАННІ ПЕДАГОГІЧНИХ НАВИЧОК У СИСТЕМІ ПРОФЕСІЙНОЇ ОСВІТИ

У статті теоретично обґрунтовано необхідність реорганізації методологічної системи впровадження програм на основі штучного інтелекту в професійній освіті та визначено перспективи використання запропонованої методології для вдосконалення підготовки майбутніх фахівців професійної освіти в контексті освітніх трансформацій. Визначено зміст поняття «штучний інтелект» та розкрито його основні риси та особливості. У контексті впровадження методології рекомендовано використовувати у сфері професійної освіти такі програми штучного інтелекту: SlideBot, Quizlet, DALL-E, Bard, ChatGPT у процесі вивчення дисципліни «Основи штучного інтелекту» в процесі вивчення освітньо-професійних програм «Професійна освіта. Технологія продукції легкої промисловості (швейні вироби)» та «015 – Професійна освіта. Транспорт (технічне обслуговування та ремонт автомобілів)». Запропоновано модель використання штучного інтелекту в професійній освіті, яка включає такі етапи: аналіз та визначення потреб, розробку методологічних принципів, упровадження та пілотування, масштабування та поширення, моніторинг та оцінку. Представлена модель базується на трьох взаємопов'язаних компонентах готовності, а саме: мотиваційно-цільовому, змістовно-діяльнісному та критеріально-оцінювальному. Актуальність представленої методології оцінювалася за трьома рівнями: високим, середнім та низьким.

Перспективи розвитку включають формування етичних принципів використання ШІ, захист даних, удосконалення методів навчання, співпрацю з ІТ-компаніями та оцінку ефективності впровадження. Перспективними напрямками розвитку є: формування етичних принципів використання ШІ, забезпечення недискримінації та захисту персональних даних; дослідження моделей співпраці людини та ШІ; створення методичних посібників, курсів, етичних кодексів; налагодження співпраці з ІТ-компаніями та науковими установами; систематична оцінка ефективності та розвиток спільнот практиків.

КЛЮЧОВІ СЛОВА: *нейронні мережі, цифрові технології, компоненти готовності, модель впровадження, електронні сервіси.*

Конфлікт інтересів

Автор заявляє, що конфлікту інтересів щодо публікації цього рукопису немає. Крім того, автор повністю дотримувався етичних норм, включаючи плагіат, фальсифікацію даних та подвійну публікацію.

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