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Methodological aspects of using artificial intelligence in the preparation of future vocational education specialists

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■ **Abstract.** Artificial intelligence significantly influences the transformation of education, science, and society, marking a new stage in the development of technologies. Its active integration into the educational process enhances the level of interactivity and personalisation of learning. This article aimed to investigate the methodological foundations of applying artificial intelligence systems in vocational education and to experimentally test a pedagogical system for developing vocational education learners' readiness to use artificial intelligence. Theoretical evidence supported the need to improve the methodology for implementing artificial intelligence based programmes in vocational education and outlines the potential for using the proposed methodology to enhance the training of future vocational education specialists in the context of educational transformations. The concept of "artificial intelligence" was defined, with its main characteristics and features outlined. This study presented a methodology for the successful implementation of artificial intelligence systems in the preparation of specialists in the field of vocational education. It has been identified that the promising directions for improving the implementation of educational programmes aimed at training future specialists in vocational education through the use of artificial intelligence systems include specific recommendations on the methodology of their application during the teaching of the course "Fundamentals of Artificial Intelligence". In the context of implementing this methodology, it was recommended to use the following artificial intelligence services: SlideBot, Quizlet, DALL-E, Gemini, and ChatGPT in the teaching of the "Fundamentals of Artificial Intelligence" course within the implementation of educational and professional programmes in "Vocational education. Technology of light industry products (garments)" and "Vocational education. Transport (Car maintenance and repair)". A pedagogical system for developing vocational education learners' readiness to use artificial intelligence has been proposed, which includes the following stages: needs analysis and identification, development of methodological foundations, implementation and piloting, scaling and dissemination, monitoring and evaluation. The presented pedagogical system was based on three interrelated components of readiness formation: motivation-goal, cognitive-activity, and results evaluation. The effectiveness of the presented pedagogical system was assessed at three levels: high, medium, and low

■ **Keywords:** digital technologies; pedagogical system; educational transformations; readiness formation; interactive learning

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Introduction

Despite the challenging political and economic circumstances brought about by Russia's 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 outlining the directions for the development of artificial intelligence (AI) in the country until 2030. This document envisages the active use of AI technologies in education, the economy, public administration, and other areas to enhance Ukraine's competitiveness in the global market. The following year, the Ministry of Education and Science unveiled an ambitious "Education 4.0" program designed to modernise the education system in line with contemporary challenges and take into account Ukraine's recovery plan. This program is part of the national strategy for the development of AI (Institute of Artificial Intelligence Problems, 2021). Ukraine is making significant strides in AI research. Scientists from institutions such as the V.M. Glushkov Institute of Cybernetics, the Institute of Artificial Intelligence Problems, and Taras Shevchenko National University of Kyiv are actively developing new AI algorithms, models, and applications. Their research spans a wide range of areas and has already yielded several important results with significant potential for the advancement of Ukrainian science and economy (Baranovsky *et al*., 2022; Awasthi & Soni, 2023).

According to V. Bykov *et al*. (2020), Education 4.0 is a new paradigm in education designed to prepare individuals for life and work in the digital age. It is based on the principles of flexibility, individualisation, collaboration, and lifelong learning. One of the key components of Education 4.0 is the use of AI. AI systems can analyse data on each individual learner to create personalised learning plans. They can also automate numerous tasks typically performed by teachers, such as assessment, lesson planning, and administration. AI programs have the potential to make education more accessible to students worldwide; they can be used to create simulations and virtual environments that allow students to practice their skills in a safe and realistic setting, and they can make learning more engaging and exciting for students through the use of games, quizzes, and other interactive elements. C. Chaka (2023) demonstrated that the use of AI in vocational education can automate numerous educational processes, opening up new avenues for learners and easing the workload of educators. To compensate for the time constraints of the Education 4.0 era, where the world's information base is updated rapidly every day, educators need to utilise AI programs to make learning more diverse and engaging. This can be achieved by creating creative tasks of varying difficulty. AI is capable of generating various task options. AI allowed to experiment with different question formats and teaching methods, taking into account the diverse abilities and perspectives of students. It is important to note that many experts believe that the presence of a teacher in the classroom remains essential. AI can only complement and facilitate the work of educators, but not replace them entirely.

The world of work is changing due to technological advancements, and vocational education must keep pace with these changes. In numerous scholarly studies, C.S. González-González *et al*. (2021) argued that AI offers numerous opportunities to improve vocational education and prepare future professionals in this field to meet the demands of the modern job market. The researchers had identified key arguments in favour of using AI in vocational education: personalised learning, improved practical skills, increased accessibility of education, preparation for working with AI, and enhanced teacher efficiency. It has been shown that the use of AI in vocational education also presents certain challenges, such as potential biases in AI systems, the need to ensure cybersecurity and data privacy, and ethical considerations regarding the use of AI in education. However, the benefits of using AI in vocational education significantly outweigh the risks. AI has the potential to revolutionise vocational education, making it more personalised, accessible, efficient, and relevant to the needs of the modern job market. It is important to note that AI should not replace teachers but complement their work. Teachers play a crucial role in ensuring that students receive a highquality vocational education based on the use of digital educational resources. This research aimed to examine the methodological underpinnings of using AI systems in vocational education, as well as to empirically validate a pedagogical framework for increasing vocational education learners' preparedness to utilise AI.

Materials and Methods

As part of the experimental research, the methodological foundations for the application of AI systems in vocational education were determined. This allowed for the theoretical justification and experimental testing of the pedagogical system for developing vocational education learners' readiness to use AI. The system included the identification of the methodological foundation for forming the readiness of future professionals in vocational education and the delineation of the components of vocational education learners' readiness to use AI, namely: motivation-goal, cognitive-activity, and results-evaluation. Additionally, within the framework of the research, methods were selected to assess the development level of the components of vocational education learners' readiness at both the diagnostic and formative stages of the experiment.

The study was conducted during the 2023-2024 academic years at Khmelnytskyi National University, Khmelnytskyi, Ukraine. The sample consisted of 42 respondents studying at the Faculty of Humanities

and Pedagogy, Department of Technological and Vocational Education and Decorative Arts, under the Educational-Professional Programs "Vocational education. Technology of light industry products (garments)" and "Vocational education. Transport (Car maintenance and repair)". The control group included 20 higher education students, and the experimental group consisted of 22 participants. To address the motivational component of readiness, it is recommended to implement project-based learning (involving students in creating their own projects where they can apply their knowledge in practice), group work (facilitating collaboration and mutual support among students), competitions (organising academic competitions to boost motivation), and mentorship (pairing students with more experienced peers or faculty). To address the content-technological component of readiness, a course titled "Fundamentals of AI" was introduced into the curriculum for vocational education programs such as "Vocational education. Technology of light industry products (garments)" and "Vocational education. Transport (Car maintenance and repair)".

The aim of the course "Fundamentals of AI" was to develop students' systematic knowledge of the principles of designing and developing intelligent systems capable of learning, reasoning, and decision-making under conditions of incomplete information. Throughout the course, students were introduced to classical AI methods, modern approaches to knowledge representation and machine learning, as well as current issues and prospects for the development of the field. The implementation of the criterion-evaluation component was carried out by developing an assessment scale that took into account students' theoretical knowledge and practical skills in using AI systems, alongside conducting regular reports to assess the effectiveness of task completion.

To assess students' theoretical knowledge and practical skills in using AI systems, a four-point grading scale was developed based on the criterionevaluation component: depth of theoretical knowledge, ability to apply knowledge in practice, creativity, ability for independent learning, and adherence to ethical standards. Monthly presentations were conducted, where students presented the results of their work. Assessments were carried out using rubrics that considered the alignment of the completed work with the set tasks, the quality of presentation, originality of approach, and adherence to deadlines. At the diagnostic stage of the experiment, an anonymous survey was conducted among respondents in both the control and experimental groups. The questionnaire consisted of eight questions related to the use of AI in the educational process. The questionnaire included the following questions: Are you familiar with the AI programs SlideBot, Quizlet, DALL-E, Gemini, and ChatGPT? Do you use ChatGPT for completing academic tasks? Does the use of AI programs contribute to plagiarism in assignments? What is the role of AI systems in vocational education? Is there a need for universities to develop rules for using AI in the educational process? The questionnaire was conducted in accordance with The guidance note of the European Commission on ethics and data protection (2021). After implementing the pedagogical system, a repeated assessment of the respondents in the control and experimental groups who were taught using the experimental methodology was carried out.

Results

Rationale for the methodological aspects of using AI in vocational education

Within the scope of this research, "AI" was understood as a powerful field of computer science with significant potential, aiming to create intelligent agents capable of reasoning, learning, and acting autonomously. AI systems can process large amounts of data, identify patterns, make predictions, and make decisions, similar to how humans do (Velykanova *et al*., 2022). The rapid advancement of AI demonstrates its immense potential. AI is increasingly being used for data analysis, automation of routine tasks, and the development of innovative solutions, showcasing significant potential. Its advantages, such as replacing humans in mundane tasks, increasing productivity, and enabling effective decision-making, are becoming increasingly evident. AI algorithms can process vast amounts of data that are beyond human comprehension (Pisica *et al*., 2023; Kovachov & Suchikova, 2023).

Vocational education in Ukraine is increasingly facing the challenge of ensuring uninterrupted learning in the face of an unstable electricity supply. The use of AI and cloud technologies can be an effective solution. They allow for diversifying learning through the creation of interactive materials and personalising the educational process, improving access to knowledge by enabling students to independently study complex topics using AI tools, and increasing learning efficiency by automating routine tasks (Marienko *et al*., 2022; Cherkhatova, 2023). AI undoubtedly impacts the pace, forms, and outcomes of scientific progress in the field of vocational education. Through AI programs, it is possible to automate routine tasks such as data collection, cleaning, and analysis, freeing up time for creative and analytical work; to identify hidden patterns and relationships in data that humans might miss; to minimise human error and bias, making research more reliable; and to integrate data from various sources, stimulating collaboration among researchers from different fields. The implementation of AI in vocational education is associated with several challenges, namely: the risk of a digital divide and the need to adapt to new working conditions. To successfully implement AI in vocational education, it is necessary to provide access to retraining programs for educators, develop research in the field of AI by stimulating scientific developments in Ukraine,

and create a favourable environment for innovation by involving businesses in cooperation with education.

In addition to the advantages, the use of AI programs also has drawbacks that cannot be ignored. Specifically, there is a risk of establishing total control over people and collecting vast amounts of personal data, which could lead to restrictions on personal freedom (Nguyen *et al*., 2023). AI algorithms can be complex and opaque, making it difficult to understand how they make decisions. This can lead to distrust of research results and ethical issues related to bias and discrimination. By using AI, it is possible to automate many tasks previously performed by specialists. This can lead to job losses and a degradation of scientific skills. AI can be used to personalise learning, adapt educational programs to the needs of higher education students, and automate assessment. This can lead to the standardisation of education and a decrease in the role of teachers (Moroianu *et al*., 2023).

Given the rapid pace of technological development, there is reason to believe that the active implementation of AI can overcome existing shortcomings in the future. Through a wise combination of AI, the human factor, government oversight, and a well-developed methodological system for using AI in vocational education, it will be possible to create an effective and safe professional training system in Ukrainian higher education institutions, based on digitalisation. The use of AI in vocational education must be conducted ethically and responsibly, taking into account all possible risks and benefits. Clear ethical principles and standards must be developed to govern its use in scientific research and educational activities. The use of AI in education has prompted mixed reviews in terms of academic integrity. On the one hand, there is a risk of plagiarism and other forms of misconduct, as AI programs can be used to generate text, translate languages, and complete assignments without a deep understanding of the material. On the other hand, AI can become a tool for better understanding and assessing students' knowledge, as well as for personalising 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 rules and expectations regarding the use of AI in the educational process, as well as teach learners the ethical principles of working with this technology (Popenici & Kerr, 2017; Ungerer & Slade, 2022). AI systems and vocational education are becoming increasingly inseparable. Vocational learners are already actively using AI systems to search for information, complete assignments, and prepare for exams. Educators need to understand and use AI to improve the educational process, making it more dynamic, interactive, and personalised. AI can help educators: automate routine tasks such as grading assignments and assessing knowledge, create individualised learning plans for each vocational learner, and provide them with access to additional learning resources and tools, as well as evaluate the effectiveness of learning and make necessary adjustments.

Neural networks are complex machine learning algorithms that can model the workings of the human brain. They are capable of learning from data and making predictions, making them a valuable tool for vocational education. In vocational education, neural networks can be used for: speech and visual pattern recognition, personalising learning and adapting it to the needs of each individual learner, automated assessment of knowledge and providing feedback, and creating interactive learning environments (Ouyang *et al*., 2022). In Ukraine, AI systems in vocational education and academic integrity are emerging concepts that have been actively developing over the past decades (Glazunova & Shyshkina, 2018). Ukrainian society is still adapting 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 personalised. It is important to use AI ethically and responsibly. AI technologies offer a wide range of tools that can significantly simplify the work of teachers and make vocational education more effective. The following AI programs have been proposed for use in vocational education; SlideBot – an automatic presentation creation tool based on the inputted text. This tool saves time in preparation, allowing the educator to focus on teaching methodologies. SlideBot also suggests an optimal slide structure to enhance material comprehension for vocational education students. Quizlet – a tool for creating flashcards with questions and answers, automatically generating tests, interactive games, automatic answer checking, result analysis, and recommendations for further learning. Quizlet helps educators better understand the needs of vocational education students and offers a personalised approach to learning; DALL-E – a tool for creating images and videos based on textual descriptions. DALL-E allows for the visualisation of historical events, generates videos with audio descriptions, makes learning more engaging, and fosters deeper immersion for students in the material (Pankratova & Sholokhov, 2019; Sabzalieva & Valentini, 2023).

The integration of AI into vocational education can significantly enhance its efficiency and quality by reducing preparation time, automating routine tasks, saving resources, employing personalised learning approaches, adapting to the needs of each individual learner, differentiating tasks, increasing motivation and interest in the subject matter, enabling deeper immersion in the material, utilising interactive and engaging learning formats, collecting data on learning outcomes, identifying topics requiring further study, and monitoring the progress of vocational learners (Holzinger *et al*., 2023). To effectively implement AI in vocational education, it is necessary to clearly define the priority areas of its

application. Analysing successful case studies will help to formulate recommendations for the development and implementation of new AI solutions that are most relevant to Ukrainian vocational education institutions. AI has significant potential to revolutionise scientific research and the educational process. However, it is important to be aware of the ethical dilemmas associated with its use and to take steps to address them. Only through an ethical and responsible approach can AI become a truly valuable tool for the development of vocational education.

Peculiarities of enhancing the methodological aspects of using AI in vocational education

The integration of AI into vocational education presents new opportunities to enhance learning quality, personalise the educational process, and prepare professionals who meet the demands of the modern job market. However, the effective use of AI in this field requires a clear methodology that takes into account the specific characteristics of vocational education and the needs of its participants. During the experimental research, the main components of the methodology for using AI in vocational education were identified. The outlined methodology includes several key aspects. The analysis of needs and opportunities involved evaluating current processes, such as existing curricula, assessment methods, infrastructure, and resources, while identifying problem areas where AI can provide the greatest benefit, including personalising learning, automating routine tasks, and analysing large volumes of data. It also included evaluating technical readiness, focusing on the availability of necessary equipment, software, and infrastructure to support AI systems. The development of an implementation strategy focused on defining clear goals, such as improving the quality of learning, increasing student motivation, and optimising the work of educators. It also involved researching and selecting appropriate AI tools that meet the institution's needs and creating a detailed roadmap for implementation, including stages, timelines, responsible parties, and required resources. Teacher training plays a critical role. This included conducting workshops and seminars to familiarise educators with AI capabilities and providing skills to work with new technologies. It also redefined the teacher's role in the context of AI, emphasising creative and communication skills, and fosters a community of practitioners to facilitate experience sharing and mutual support. Building infrastructure ensured the availability of necessary equipment, such as computers, networks, and software, to support AI systems. Measures for data protection were implemented to ensure the security and confidentiality of student information, while AI systems were integrated with the institution's existing information systems. Phased implementation and evaluation involved starting with small projects and gradually expanding the areas of AI application. Feedback was collected from students, teachers, and administrators regarding the effectiveness of the implemented tools, and regular monitoring and evaluation are conducted to assess outcomes and make necessary adjustments. Finally, continuous development was essential. This included keeping track of the latest advancements in AI, ensuring timely updates to tools in use, providing ongoing user support, and continuously improving curricula to incorporate new AI capabilities.

The key factors for the successful implementation of AI in vocational education include taking into account the specific characteristics of each educational institution and the needs of its students. Engaging all stakeholders in the implementation process (teachers, students, administration, and parents) is crucial. Phased implementation of AI should be adopted to avoid overwhelming the system. Regular evaluation of the implementation outcomes and making necessary adjustments is essential. Continuous support should be provided to users and educators. Considering the outlined research objectives, a survey was conducted during the initial phase of the experiment. The results revealed that 82% of respondents are familiar with AI programs such as SlideBot, Quizlet, DALL-E, Gemini, and ChatGPT. Of these, 43% have used ChatGPT to complete academic tasks, and 78% acknowledge that the use of AI systems may lead to plagiarism. Furthermore, 14% of respondents admitted to using AI systems to complete tasks and submit the results as their own work. 52% of respondents believe that AI systems can be beneficial in vocational education if used ethically, and 87% think that universities need to establish clear guidelines for the use of AI in the educational process. It can be concluded that, overall, vocational education students have a positive attitude towards the use of AI programs in education and actively utilise them. To assess the readiness of higher education students to utilise AI in vocational education, a pedagogical framework was developed during the baseline phase of the experiment. This framework was structured around three key components of readiness: motivation-goal, cognitive-activity, and resultsevaluation.

The motivation-goal component of readiness involved the methodological foundation for using AI in vocational education. The aim of developing the pedagogical system was to enhance the methodological aspect of AI usage in vocational education, which included motivating students to incorporate AI into their professional activities. The following methodological approaches were used as the basis: systemic, student-centred, activity-based, conceptual, and multi-subject, along with the principles of teaching: clarity (using visual materials, such as images, diagrams, and tables, for better understanding and assimilation of information); natural correspondence; activity (stimulating active participation from vocational education students in the learning process, employing interactive teaching

methods and AI); systematisation and consistency (ensuring logical connections between topics and lessons, with a gradual increase in the complexity of the material); perspective and continuity (considering the future development of student's knowledge and skills, ensuring continuity between previous and subsequent learning material); and humanisation (creating an atmosphere of trust and cooperation, respecting students' opinions and feelings).

The cognitive-activity component of readiness focused on the methods and techniques of integrating AI into vocational education. This involved selecting appropriate AI software and determining how it could be effectively used in the learning process. To ensure the effectiveness of this approach, student learning outcomes were regularly assessed, allowing for necessary adjustments to be made. The results-evaluation component of preparing vocational education learners for the digital transformation of education plays a crucial role as it allows for the assessment of the effectiveness of AI systems within the educational process. The findings from this component aid in adapting educational practices to contemporary demands and ensuring that vocational learners are adequately prepared for life in a digital society. Figure 1 presents the results of the assessment of vocational learners' readiness to use AI, as measured by the defined components at the baseline stage of the experiment.

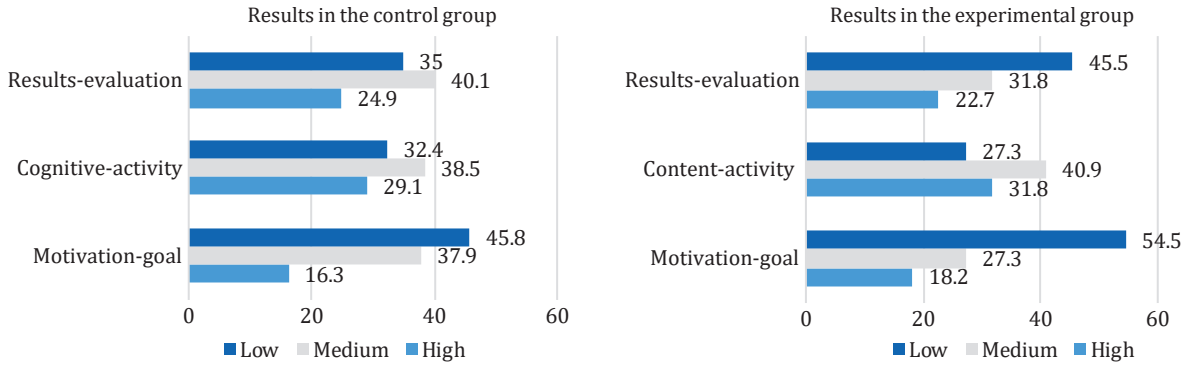

Figure 1. *Assessment results of vocational learners' readiness based on the defined components in the control and experimental groups at the diagnostic stage of the experiment, %*

Source: *created by the authors*

Considering the results of the research, there is a need to develop clear guidelines for the use of AI in vocational education. These should include defining acceptable and unacceptable practices; conducting educational discussions with students on the ethical use of AI systems and academic integrity; equipping educators with the ability to offer students alternative methods and tools for completing tasks that do not require the use of AI; developing an updated methodology for the use of AI in vocational education; and conducting further research into the impact of AI on the educational process and academic integrity in vocational education.

The findings of the diagnostic stage of the experiment revealed that participants in both the control and experimental groups exhibited low to moderate levels of readiness to use AI systems in their professional work. This suggests a reluctance to embrace professional development in this area. The insufficient development of the cognitive-activity component of readiness further highlights the need for a revised pedagogical approach to AI integration in vocational education. Additionally, the motivation-goal component requires improvement. This is because it is crucial to understand the necessity of AI and to be able to assess the skills and knowledge in this field.

Therefore, it was necessary to conduct a formative stage of the experiment. This stage aimed to integrate a pedagogical system designed to prepare students for using AI in their future professions. The control group followed traditional teaching methods, while the experimental group was taught using a new approach that incorporated digital educational resources powered by AI. The proposed pedagogical system includes the following stages. Analysis and identification of needs (conducting a comprehensive study of the needs and expectations of stakeholders in vocational education, including educators, students, employers, and government bodies; identifying key competencies and skills to be developed in students as part of their professional training; analysing the available resources and infrastructure for implementing AI in vocational education). Development of methodological foundations (determining the methodological approaches and principles for using AI in vocational education, considering ethical standards, accessibility, and inclusivity; developing methodological recommendations for selecting and integrating AI tools in vocational education; creating training programmes and courses for preparing educators to use AI in vocational education). Implementation and piloting (development and implementation of pilot projects using AI in vocational education across various fields and levels of training; evaluating the effectiveness of AI tools and their impact on student learning

outcomes; adjusting methodological foundations and recommendations based on the results of pilot implementation). Scaling and dissemination (developing a strategy for scaling the use of AI in vocational education at national and regional levels; creating platforms and resources to support educators and students in using AI; ensuring cooperation with government bodies, employers, and other stakeholders to promote the use of AI in vocational education). Monitoring and evaluation (ensuring continuous monitoring and evaluation of the effectiveness of AI use in vocational education; collecting and analysing data on the impact of AI on learning outcomes, student motivation, and satisfaction of educators and employers; making adjustments to the methodology and practices of AI use based on the results of monitoring and evaluation).

The implementation of this system for improving the methodological aspects of using AI in vocational education is expected to result in enhanced quality and effectiveness of professional training, personalisation of the educational process and adaptation to the individual needs of students, development of new competencies and skills in students that meet the challenges of the modern labour market, increased motivation and engagement of students in learning, and improved collaboration between educators, students, employers, and government bodies. The use of AI has the potential to revolutionise vocational education and training, preparing professionals to meet the demands of economy. The proposed pedagogical system for improving the use of AI in vocational education can serve as a blueprint for developing and implementing effective AI strategies in this field.

AI is reshaping education, transforming it into a personalised and adaptive process. E-learning platforms like Enlearn employ machine learning to generate tailored learning paths that cater to the unique needs of each student. This approach not only accelerates knowledge acquisition but also makes learning more engaging and effective. Learning Management Systems (LMS) are pivotal in driving this transformation. Beyond centralising educational processes, they foster collaboration between instructors and students. LMS enables organisations to create flexible and dynamic learning environments that meet the demands of the modern world. AI is revolutionising e-learning, transforming it from passive content consumption into an active engagement process. For Generation Z, who value self-directed learning and continuous growth, AI offers new avenues to achieve their goals.

Systems like ALEKS tailor education to the needs of each individual learner by assessing their knowledge and providing personalised assignments. The uniqueness of ALEKS lies in the fact that it does not simply deliver learning materials but creates a customised learning path for each student. The system first evaluates the student's knowledge level and then constructs a personalised plan that helps the student focus on crucial topics and reinforce new material. AI is used in education for various purposes, ranging from the creation of personalised learning plans (as seen in ALEKS and Squirrel AI) to the automation of routine tasks, such as grading homework (Holmes *et al*., 2022). Consequently, following the initial diagnostic stage of the experiment, data was collected on the initial state use of AI systems in vocational education. AI programs were investigated, and their application methods were outlined. Subsequently, an experimental pedagogical system for using AI in vocational education was developed and implemented. The effectiveness of this AI-integrated pedagogical system in vocational education was evaluated by measuring the extent to which learners had developed specific components of readiness to use AI systems. The results of the distribution of respondents by their readiness to use AI at the stage of the formative experiment are presented in Figure 2.

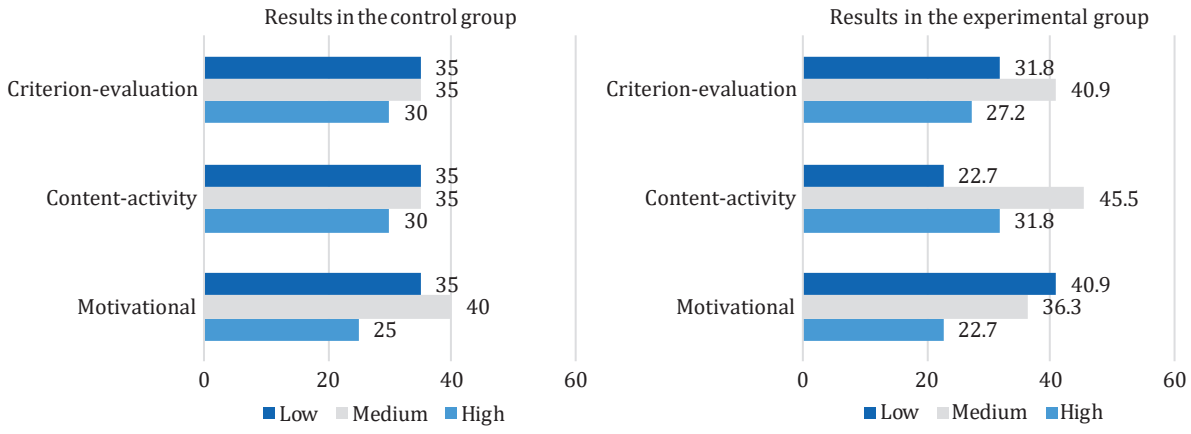

Figure 2. *Assessment results of vocational learners' readiness based on the defined components of the developed pedagogical system for using AI in vocational education, in both the control and experimental groups at the formative stage of the experiment, %*

Source: *created by the authors*

Based on the results of the study, it was found that the updated methodology for the use of AI in vocational education is effective, as in the experimental group, during the formative stage of the experiment, the indicators increased to an average and high level compared to the data obtained at the diagnostic stage of the experiment. It was determined that students in the experimental group exhibited greater motivation to use AI in their studies. Factor analysis identified three primary factors influencing students' readiness to use AI: motivation, digital competence, and attitude towards new technologies. Regression analysis revealed that digital competence was the strongest predictor of students' readiness to use AI. Analysis of the survey results revealed that students in the experimental group, who participated in learning activities using SlideBot, Quizlet, DALL-E, Gemini, and ChatGPT, demonstrated a significantly higher level of knowledge about the principles of AI and its poten tial applications in education compared to students in the control group. The use of AI in research opens up new possibilities for improving efficiency and quality. To ensure academic integrity, clear guidelines must be followed. Plagiarism, data falsification, and using AI for mass production of low-quality publications are unacceptable. Every researcher must independently analyse the results obtained using AI and ensure proper citation of all sources used, including AI data and algorithms. It is crucial to consider the potential risks associated with algorithmic bias and data privacy.

Therefore, AI is closely linked to open, contemporary science through its work with big data. It organises information, analyses it, and facilitates further research. In education, AI can serve as a teaching assistant, creating personalised learning experiences. However, there are risks: diminishing the role of the teacher, reducing the creativity of learners, and exacerbating the digital divide. In the training of future professionals in vocational education, AI systems can personalise learning, providing a tailored approach for each student. In science, AI automates routine tasks, analyses large datasets, and assists in generating new hypotheses. However, it is important to understand that AI does not replace human intelligence but is rather a powerful tool. To effectively utilise AI, ethical standards must be developed and potential risks, such as diminishing the role of teachers in education and potential biases in AI algorithms, must be considered. AI has the potential to revolutionise education by making it more personalised, efficient, and accessible. However, it is crucial to understand that AI does not replace the teacher but acts as a powerful tool. The key to successful AI implementation in education lies in a judicious combination of technology and human expertise.

Discussion

Ukraine aspires to become a leader in the field of AI. To achieve this goal, an ambitious eight-year strategy (2023-2030) has been developed. It outlines a phased implementation of measures under government oversight. The legal foundation for the strategy is provided by the country's constitution and a series of specialised laws. This document will serve as a roadmap for AI development in Ukraine, as state programs will be developed and new laws enacted based on it (Resolution of the Cabinet of the Ministers of Ukraine No. 286-2022-p, 2022). The presented document substantiated the urgent need for a transformation of educational programs in Ukraine to cultivate highly skilled professionals in the field of AI. According to the proposed strategy, the integration of AI elements into school curricula and higher education programs is envisioned to foster a foundational understanding and interest in this field among the youth. The establishment of specialised undergraduate, graduate, and doctoral programs focused on training AI researchers and engineers is a pressing requirement. There is a need to develop online courses, mobile applications, and other interactive tools for distance learning and professional development, as well as to intensify collaboration between universities and IT companies to develop joint curricula, internships, and research laboratories. Inviting leading global AI experts to deliver lectures, seminars, and conduct joint research is essential. Securing stable funding for AI research projects from both government budgets and private investments is crucial (Crompton & Burke, 2023).

The expected outcomes include enhancing Ukraine's competitiveness in the global technology market, creating new jobs in high-tech sectors, accelerating the development of an innovation-driven economy, and strengthening the country's scientific capacity. Key advantages of the proposed strategy are: encompassing all levels of education from school to postgraduate studies, emphasising the acquisition of practical skills and innovation implementation, uniting the efforts of experts from various fields, and integrating Ukraine into the international scientific and educational landscape. The implementation of this strategy will enable Ukraine not only to catch up with global leaders in AI but also to become a hub for global innovation (Uzwyshyn, n.d.).

In examining the application of AI in education, I. García-Martínez *et al*. (2023) identified the core features of AI. They have furthered the argument for the integration of AI into vocational education, citing it as a necessity in today's increasingly digital society. This approach is deemed appropriate as AI systems employ sophisticated algorithms to analyse and interpret data from various sources, including text, images, audio, and sensory data. They are capable of learning from experience and improving their performance over time. This is often achieved through machine learning, which involves the automatic identification of patterns in data without explicit programming. AI systems can make autonomous decisions based on the data they analyse and the knowledge they acquire. They can perform a

variety of tasks, such as image recognition, machine translation, text generation, planning, and navigation.

S.Z. Salas-Pilco & Y. Yang (2022) extensively explored methodologies for integrating AI into the training of future professionals. The researchers identified several types of AI: narrow (focused on performing a specific task or set of tasks, such as facial recognition or playing chess), general (possessing general cognitive abilities), and superintelligence (surpassing human intelligence in all aspects). The utilisation of this classification is deemed appropriate as the developed AI methodology incorporates these identified types. The implementation of this methodology is highly relevant given the anticipated emergence of "digital universities" in the near future, which will be grounded in virtual reality and AI. This underscores the active integration of digital technologies into educational transformation. Considering challenges related to technological infrastructure, the primary task becomes transforming the education system to overcome these obstacles. To this end, numerous educational resources and digital platforms are being developed to support and create educational content.

The research by O. Yara *et al*. (2021) was based on the concept of adaptive learning, which involves the continuous modification of the educational process according to the individual achievements of higher education students. Analysis of the research findings revealed that the next phase of machine learning algorithm development enables AI systems to analyse vast amounts of data, identify patterns, and predict the future progress of each student. The authors demonstrated that AI in professional education can not only automate routine tasks for educators but also facilitate a deeper understanding of the educational process.

For instance, H.-C. Chu *et al*. (2022) in their numerous studies have highlighted that higher education learners' readiness to effectively use AI is a complex phenomenon encompassing not only technical skills but also understanding, attitude, and willingness to adapt to the changes brought about by AI development. Technical skills include understanding the fundamental principles of artificial neural networks, machine learning, deep learning, and other key concepts; proficiency in programming languages used for developing AI models (such as Python, R, and Java); ability to work with various tools and platforms for creating, training, and deploying AI models (like TensorFlow, PyTorch, and Google Colab); and skills in collecting, cleaning, processing, and analysing data for training AI models. Digital literacy encompasses knowledge of contemporary digital technologies and their applications in various fields, confident use of computers, the internet, and a variety of software products, the ability to critically evaluate information from diverse sources, and the detection of misinformation. Soft skills encompass the ability to generate novel ideas and unconventional solutions, analyse information, identify errors, and make informed decisions. They also include effective communication, teamwork, and presentation skills, as well as an understanding of the ethical implications of AI and the responsibility for one's actions. Understanding the potential and limitations of AI involves recognising potential negative consequences (such as job displacement and algorithmic bias), evaluating AI model performance, and identifying their shortcomings. Readiness to collaborate with AI entails understanding that AI is a tool to assist humans rather than replace them, and the ability to adapt to new ways of working enabled by AI. Developing these components in higher education students is a crucial task for universities and educational institutions. This will enable the training of professionals in vocational education who can effectively utilise AI to solve complex problems and contribute to the growth of an innovative economy.

K. Alhumaid *et al*. (2023) argued that several models exist in contemporary research to describe the future development of AI. Some of these models include exponential growth (predicting that AI development will accelerate at an ever-increasing pace); S-curve (suggesting that AI development will follow an S-shaped curve, initially slow, then rapid, and finally slowing again); and technological singularity (postulating that AI will eventually surpass human intelligence, leading to radical societal changes). The use of these models is deemed appropriate as they are reflected in the presented research on methodological aspects of using AI in vocational education. The application of AI in vocational education offers numerous advantages. AI systems enable the creation of personalised learning plans that cater to the individual needs and learning styles of each student. They can automate many tasks, freeing up educators' time for more creative interactions with students. AI can make education more accessible to students with diverse abilities. AI is becoming an increasingly powerful tool for enhancing education. Due to its capabilities in personalisation, automation, and accessibility, AI has the potential to revolutionise the field of education.

Conclusions

AI is increasingly being integrated into education, offering new opportunities for personalised learning and the automation of routine tasks. The widespread use of AI has raised concerns about its impact on the role of educators, the development of students' creativity, and the widening of the digital divide. The research demonstrated that ensuring the quality of the educational process for vocational education students in Ukrainian higher education institutions relies on highquality methodologies for organising work with AI programs.

AI has been identified as a driving force behind global change. Its impact is felt across all spheres of life, from economics to culture. This research defined the concept of AI and explored its characteristics and

features. A methodology for integrating AI into the training of vocational education specialists was presented. A pedagogical system has been developed to foster readiness for the use of AI among vocational education students. This system consisted of three interconnected components: motivation-goal, cognitive-activity, and results-evaluation.

A comprehensive analysis of the scientific literature has enabled the systematisation of understanding regarding the application of AI systems in vocational education, and the identification of the key components of a methodology for addressing this issue in the training of future specialists. To empirically verify the effectiveness of the proposed pedagogical system for developing the readiness of professional education students to use AI, both diagnostic and formative experiments were conducted, during which appropriate diagnostic methods were employed.

Promising areas of research on the use of AI in the educational process include the study of the ethical aspects of AI in education (developing ethical principles for the use of AI in education, ensuring fairness and preventing discrimination); data protection (developing effective methods for safeguarding students' personal data used by AI systems); human-AI collaboration (researching optimal models of interaction between humans and AI in the educational process); the development of detailed methodological guides and instructions, creation of specialised courses and training programmes, development of university standards and ethical codes, collaboration with IT companies and research institutions, systematic evaluation of effectiveness, and the establishment of a community of practitioners.

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Conflict of Interest

None.

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Методичні аспекти використання штучного інтелекту в підготовці майбутніх фахівців з професійної освіти

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Анотація. Штучний інтелект здійснює значний вплив на трансформацію освіти, науки та суспільства, позначаючи новий етап у розвитку технологій. Його активна інтеграція в освітній процес сприяє підвищенню рівня інтерактивності та персоналізації навчання. Мета статті полягала у дослідженні методичних основ застосування систем штучного інтелекту в професійній освіті та експериментальній перевірці педагогічної системи формування готовності майбутніх фахівців з професійної освіти до використання штучного інтелекту. Теоретично доведено необхідність удосконалення методики впровадження програм на основі штучного інтелекту у професійній освіті та визначено перспективи використання запропонованої методики для вдосконалення підготовки майбутніх фахівців з професійної освіти в умовах освітніх трансформацій. Визначено зміст поняття «штучний інтелект» та розкрито його головні ознаки і особливості. У цій роботі представлено методику впровадження систем штучного інтелекту у підготовку майбутніх фахівців з професійної освіти. Визначено перспективні напрямки удосконалення реалізації освітніх програм підготовки майбутніх фахівців з професійної освіти з використанням систем штучного інтелекту та надано рекомендації з методики їх застосування. У контексті реалізації даної методики у процесі реалізації освітньо-професійної програми другого (магістерського) рівня вищої освіти «Професійна освіта (Цифрові технології)» при викладанні дисципліни «Цифрові інструменти у професійній освіті» було застосовано наступні сервіси штучного інтелекту SlideBot, Quizlet, DALL-E, Gemini, ChatGPT. Було запропоновано педагогічну систему формування готовності майбутніх фахівців з професійної освіти до використання штучного інтелекту, яка включає наступні етапи: аналіз та визначення потреб, розробка методологічних засад, впровадження та пілотування, масштабування та поширення, моніторинг та оцінка. Представлена педагогічна система ґрунтується на трьох взаємопов'язаних компонентах формування готовності, а саме: мотиваційно-цільовий, когнітивно-діяльнісний та результативно-оцінний. Оцінка ефективності представленої педагогічної системи здійснювалася за трьома рівнями: високий, середній та низький

Ключові слова: цифрові технології; педагогічна система; освітні трансформації; формування готовності; інтерактивність навчання