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Problems of training civil servants in the post-Soviet higher educational institutions

Abstract. The study of problematic aspects in training civil servants in the post-Soviet countries is extremely relevant. This, relates to the active policy of retraining workers per European approaches. Thus, the study of the problems that currently impede the effective training of civil servants allows finding solutions and improving them. Based on this, the purpose of this study was to analyse the main approaches and tools used by the post-Soviet higher educational institutions to train civil servants. Accordingly, to achieve it, the study used various scientific and methodological means, including functional and systematic approaches, as well as the method of analysis and synthesis, comparison, deduction, and generalisation. As a result, both the theoretical and practical part of the question was covered. The first half of the study defined the essential content of the main concepts and terms related to the subject under study, as well as covered their features. In addition, the methods and approaches that are fundamental in the training of civil servants in the post-Soviet countries were considered in depth and their main shortcomings were shown. The study revealed that the main challenges in training civil servants in post-Soviet higher educational institutions include outdated curricula, insufficient practical training, and a lack of focus on developing critical thinking and leadership skills. Furthermore, the research identified a need for greater emphasis on ethics, transparency, and accountability in public service education. Lastly, the findings suggested that incorporating more case studies, simulations, and internships could significantly enhance the effectiveness of civil servant training programs in these countries. The practical value of the study lies in the fact that it can be used both as a methodological material for higher educational institutions, and for the personal development of individual educational workers

Keywords: learning process; competence; students; modernisation; innovative technologies

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INTRODUCTION

In the context of globalisation and the active development of society, the question of improving the qualification of civil servants is increasingly arising. Increased attention to such subjects is justified since they personify state power. Accordingly, training such individuals is extremely complex and important for society since the future development of the country depends on its success and effectiveness. Analysis of the current state of educational approaches and materials used in the post-Soviet higher educational institutions for the training of civil servants points to their problematic nature and many shortcomings. This is because to a certain extent they do not meet the challenges of modern times, and therefore civil servants who receive education in such conditions do not have a perfect level of professional training. Furthermore, the ideological part plays a significant role, namely the essential understanding of the concept of civil servants and their competence.

The available curricula designed for the study of civil servants lack the foundations affecting their socialisation and interaction with the public within their powers (Janevova, 2020). Such results were obtained because of a systematic analysis of higher educational institutions, which accordingly train future civil servants. A key area for improving the educational process is, admittedly, paying attention to assessing the quality of the acquired qualifications of property subjects of state administration and local self-government bodies. This is because the verification of the level of knowledge is key and allows for figuring out the effectiveness of the approaches used by educational institutions. Furthermore, a qualitative assessment will find the main shortcomings that need to be overcome in the development and modernisation of the educational process (Stoliarenko *et al.*, 2021).

It is also critical to analyse the problems of training civil servants in the context of full compliance or, on the contrary, non-compliance with the fundamental humanistic foundations, as well as a personality-oriented approach (Podungge *et al.*, 2021). It is significant to develop the ability for individual career development in future subjects of public authorities, but at the same time pay great attention to the work skills and interaction in a team. Based on this, overcoming the current problems existing in higher educational institutions and preparing future civil servants, to a greater extent depends on conducting an in-depth analysis, as well as understanding and substantiating its essential content, and may vary according to the established forms of its implementation and reflection of their rational correlation (Sugiono *et al.*, 2021).

Thus, the main purpose of this study was an in-depth analysis of the mechanisms and means used by the post-Soviet higher educational institutions in extending the educational process, namely training civil servants, and finding their problems and shortcomings. Accordingly, to fulfil this purpose, several tasks were performed in this study: the essence of the concept of a civil servant was found, the main differences in the ideology of the post-Soviet

countries with the subjects of public authorities were established, the approaches that are a priority during training were analysed, the practices of foreign countries were considered, promising areas for improving the training of civil servants were developed.

MATERIALS AND METHODS

To investigate the shortcomings in the approaches and tools used by the post-Soviet higher educational institutions to train civil servants, various research tools were used. This allowed fully consider and find the problematic aspects in this process, establishing the causes of their occurrence, and also forming possible ways to overcome them. It is necessary to note the functional approach, since at its expense the purpose and objectives of this study were found, and a plan for its implementation was formed. Based on this approach, the study was divided into several stages, which allowed the investigation of all the features of the subject under study more thoroughly. All the methods and methodological techniques used were interconnected through a systematic approach. This tool allowed the investigation of each of the shortcomings in the approaches of the post-Soviet higher educational institutions, in which civil servants are trained. A significant role was played by the method of analysis and synthesis. With its help, the issue under study was divided into separate elements, which allowed analysing of each of them and figuring out its properties. The synthesis method allowed for finding the common properties of such elements and the relationship between them. As a result of such a division, and then a combination, problematic aspects in the activities of higher educational institutions were found, as well as their common features were considered and the main reasons for their emergence were found. Based on the synthesis method, the necessary theoretical concepts were covered, which allowed for figuring out the essential content of the subject under study.

Equally significant was the method of comparison since it allowed comparing the main shortcomings of curricula and approaches. This method allowed, based on a comparison of such problematic aspects, to find the main ways to overcome them. The comparison method also made it possible to substantiate the need to change the approaches in the educational activities of future civil servants to more efficient and modernised ones. The logical structure of the study was based on the dialectical method since the study progresses from general to specific. At the initial stage of the study, the main theoretical concepts and features of the issue under study were analysed. The second half of the paper specifically examines the problematic aspects, i.e., the shortcomings that currently exist in the educational activities of post-Soviet higher educational institutions, which train civil servants. To analyse the results obtained and form concise conclusions, the generalisation method was applied in this study. As already noted, the study was carried out in three stages:

1) In the first stage, a work plan was formed, and the main purpose and tasks were figured out. The theoretical part of the issue was investigated, i.e., its general aspects were considered.

2) In the second stage, shortcomings, and obstacles in the educational process in the preparation of civil servants in the post-Soviet countries were specified. Promising recommendations were formulated to resolve such shortcomings.

3) In the third stage, the results of the study were investigated, and concise conclusions were formed accordingly. Possible areas for further research on this subject were also considered.

RESULTS AND DISCUSSION

The investigation of such a topic as public service is gaining increased popularity among scientists. Scientists actively consider issues related to the professional training of civil servants. Such an elevated interest is conditioned upon the active policy of modernisation and European integration pursued by the post-Soviet countries. These actions can be considered as reforming the entire educational system. Currently, in countries such as Ukraine, Kazakhstan, Latvia, and Estonia, there is an active professionalisation of the civil service, as well as local governments, which also requires changes in the curricula used by higher education institutions. To figure out the main and most acute problems that exist in post-Soviet higher educational institutions that train civil servants, it is imperative to consider successful foreign practices and, based on the comparison, find shortcomings.

It is possible to cover the term “public service” as an interconnected system of state-legal and socio-economic institutions and organisational units aimed at performing certain state tasks and duties due to the proper performance of powers by civil servants, while unconditionally satisfying public interests. Thus, the analysis of the above system should be based on many notable features to identify problems and shortcomings, which, accordingly, reduce the level of effectiveness of the educational process and adversely affect the knowledge and competence of future civil servants. To conduct research, it is necessary to show the essence of the term “civil servant”. These are individuals whose professional activity is to create and implement management decisions, respectively, holding positions in government bodies, institutions, or the state apparatus. An essential feature of civil servants is the focus of their actions on the proper performance of state functions and powers assigned to them. Thus, the purpose of a civil servant is to satisfy the public interest, and not a personal one.

Proceeding from this, the reform of educational programs, according to which future civil servants study in post-Soviet higher educational institutions, will allow the development of the entire personnel system of public authorities and bring them as close as possible to European standards. Therewith, such improvement should be based not only on the development and implementation of new managerial skills and competencies but also on a

systematic analysis of the content and promising vectors of such changes. As a result of solving the issues existing in curricula and approaches, it is necessary to be able to freely set up a connection between the theoretical and practical foundations of the educational process, including by involving students in active practical activities. The main purpose of finding current shortcomings and eliminating them lies in the effective assimilation of modernised managerial skills and abilities by future students, i.e., reforming the system should certainly focus on the result.

As for the problems that adversely affect the educational process and the level of knowledge and competence of civil servants, they are largely provoked by the presence of irrelevant and inefficient approaches and tools used by post-Soviet higher education institutions. That is why the study of shortcomings should be based on the modernity of the materials or mechanisms used. Based on this, many other issues, including the quality and level of independence in assessing the results of educational activities of students, approaches to teaching educational information, determining the methods of communication between teachers and students, and the form of the educational process, are provoked to a greater extent by the inconsistency with the challenges of modernity and conditions related to state employees.

Thus, reforming and improving the entire structure and mechanism of professional training of civil servants should be understood as an interrelated process, the purpose of which is to modernise the functional and organisational aspects of curricula and materials based on which students receive knowledge. It is this approach that allows fully analysing of the existing approaches and tools, i.e., to figure out their effectiveness and success in the context of the educational process. A distinctive feature of this study is that the study of problems takes place within the post-Soviet higher educational institutions, which have features of the organisation of state power and the distribution of powers between the state apparatus. Accordingly, when considering current issues, attention should be paid to the form of the state, namely to the form of government and state structure. These properties are reflected in the characteristics of post-Soviet approaches to learning, especially within higher education institutions (Fahlevi, 2020).

The priority of choosing this approach is that the active use of innovative programs in training will allow using the acquired modernised knowledge in future professional activities. Achieving such a modification is possible due to the holistic filling of the entire curriculum with special mechanisms and approaches that meet the advanced world trends. Notably, the current problems of higher education institutions can only be solved through the implementation of systemic changes. Furthermore, the elimination of shortcomings and obstacles inherent in the organisation of the work of the state apparatus in the post-Soviet countries will provoke a dynamic acceleration and improvement of the educational process. The progressiveness of such actions will help increase the level

of evolutionary development of approaches to the concept of the civil servant and civil service. Thus, it can be proved that it is important to decide on the active introduction of modern world practices to the curricula and approaches, which should be harmonising with the national traditions and values existing in these countries. One should also pay attention to the fact that the solution to certain issues will allow the development of the current mechanism for the professional training of civil servants to a higher level (Kryvtsova *et al.*, 2021).

After analysing the general theoretical provisions covering the essential content of the current shortcomings of the educational system, as well as substantiating the priority of introducing changes, it is possible to more specifically study each of the problems and model workable solutions. Consequently, all higher educational institutions that are state-owned and found in the post-Soviet countries are based on a special approach to the organisation of the educational process. This mechanism lies in the approval of a special plan for the staffing of the state apparatus, as well as regulations of the highest bodies of state power. Therewith, this mechanism is quite complicated, since it requires certain educational and professional plans and procedures designed for the training and retraining of civil servants, who to a greater extent do not meet the necessary conditions of modern society. An essential element of the educational process in the post-Soviet countries is its compliance with national standards, which were adopted and defined quite a long time ago, which indicates their inefficiency. Based on this, an in-depth analysis of the problems impeding the quality training of civil servants in higher education institutions should begin with the constituent provisions, since they are the basis and source of many other shortcomings (Goncharuk *et al.*, 2021).

In addition, when studying the process of training civil servants, public authorities are a vital part of the educational system. Their role in teaching students of this speciality is to control the learning process of future civil servants. However, not in the usual attestation form, but in a special one. It is revealed during a special meeting of students for practical training, within certain territorial bodies of state power or local self-government. Based on the general problems relating to the entire post-Soviet space showed above, it can be argued that the mechanism for training, retraining, and advanced training of civil servants and officials of local self-government is at a satisfactory level. Moreover, these shortcomings are common among many educational institutions, which shows that they do not have special modernised tools and mechanisms.

If one explores more local problems related to certain academic disciplines, then they can be revealed through the generally named problems. Accordingly, one of the most negative among them is the lack of consistency in the educational process and future practical activities of students. This aspect is reflected in the entire educational process, since it must be integral and structured, and academic disciplines – interconnected. In turn, now, in the universities

of many post-Soviet countries, one can see disagreements in approaches to the definition of individual academic disciplines. An example of this issue is the presence of such educational areas as public administration and management of public affairs, as well as many others. Therewith, in countries such as Uzbekistan, there are currently about ten such academic disciplines, which to a certain extent even contradict each other, and, accordingly, are inconsistent with the general and priority educational and professional program “Public Administration”.

Based on the named problem, it is necessary to change and modernise the initial methodological materials and tools dependably. However, special attention must be paid to understanding the purpose of such a reform, i.e., to figure out an improvement plan and consider not only changes that would affect the educational process, but also students, i.e., future civil servants. Thus, innovations should have a specific and reasonable list of the necessary knowledge, skills, and abilities that will be obtained by the subject because of passing a modernised educational and professional program (Eckel, 2023).

Furthermore, it is necessary to address the fact that another rather principal issue, especially for higher educational institutions in Ukraine, is the poor-quality division of specialities and educational qualification programs. It is necessary to distribute the above elements not by category of positions, but by certain positions of civil servants, as well as particular officials of local self-government. Therewith, this process should be more thorough and based on the personal qualities of the students (Millin, 2021). Analysing the modernisation and development of both curricula and methodological support, it should be modelled and have a clear target orientation. Introducing the necessary changes is a complex process, since it requires modification not only of local documents and relevant plans, but also of generally binding legal acts that have great legal force. Thus, the reform should concern the content of the above elements, as well as constitute an integral, interconnected system of training, retraining, and advanced training of civil servants. It is the choice of such an approach that will allow fully modernising the entire national educational system, which, as a result, will combine the educational activities of students with professional employment into a single mechanism for the continuous training of civil servants (Tokbaeva, 2021).

Furthermore, the solution of certain problems should be based on changes to the nationwide system of educational and professional training of civil servants and be aimed at strengthening the principles of manageability of the activities of the entire structure of state authorities and local self-government. Based on this, not only the educational system should undergo modification, but also the mechanism of interconnection and communication of the actions of all post-Soviet higher educational institutions and those implementing educational activities in the context of public service. Therewith, it is imperative to consider departmental types related to the

distribution of branches of power, as well as the organisation of the activities of their bodies and the allocation of levels (Vavreniuk *et al.*, 2021).

Consequently, the current state of development of higher education institutions in the post-Soviet space is insufficient, which is fully reflected in the level of competence of civil servants. The main problem is the division of professional training of officials of certain categories and positions. Since this process relates to the competence of various educational institutions, which provokes many issues in the future educational activities of students (Sanghera & Satybaldieva, 2020). A decisive step allows carrying out a general education reform is the formation of special subordinate bodies that control the process of reforming curricula and materials for civil servants. Moreover, this approach will enable timely identification of shortcomings that may arise in the future professional activities of civil servants and local self-government officials. An important process of modernisation of the educational system is also the organisation of periodic thorough monitoring of the competence and skill level of the state apparatus. This stage is essential because it allows figuring out the questions that need to be introduced into the curricula and explain to the students accordingly. Thus, because of the implementation of the proposed changes, there will be an increase in the level of efficiency of the educational process, as well as the quality of teaching materials. After overcoming the problems found in the study, general educational approaches and tools for the implementation of educational activities should be changed. Most importantly, as a result of reforming the educational industry, there will be an improvement in the ways of organising state power, since the state apparatus will be somewhat re-equipped both in a theoretical and practical sense by increasing the level of knowledge and competence of civil servants, as well as introducing innovative programs and technologies into professional activities (Gnusowski, 2021).

One of the significant challenges in training civil servants in post-Soviet higher educational institutions is the lack of emphasis on developing critical thinking and analytical skills. Traditional teaching methods often prioritise rote learning and memorisation over problem-solving and decision-making abilities (Huseynli, 2023). This approach fails to prepare future civil servants for the complex, dynamic challenges they will face in modern public administration. To address this issue, educational programs should incorporate more case studies, simulations, and interactive learning experiences that encourage students to apply theoretical knowledge to real-world scenarios (Fedotova, 2020).

Another crucial aspect that requires attention is the integration of technology and digital skills into the curriculum (Chankseliani, 2022). As governments worldwide are increasingly adopting e-governance and digital solutions, civil servants must be proficient in using and understanding these technologies. Many post-Soviet higher educational institutions lag behind in incorporating digital literacy and e-governance concepts into their programs. This

gap needs to be bridged by introducing courses on digital transformation in public administration, data analytics, and cybersecurity, ensuring that future civil servants are well-equipped to navigate the digital landscape of modern governance (Larina & Larin, 2022).

Furthermore, there is a pressing need to strengthen the focus on ethics, transparency, and accountability in public service education (Sparks & Reading, 1994). While these concepts are often mentioned in curricula, they are not always given the depth and practical application they deserve. Developing a strong ethical foundation and understanding of good governance principles is crucial for building trust between citizens and the government. Educational programs should include more comprehensive modules on ethics in public service, anti-corruption measures, and strategies for enhancing transparency in government operations (Baimenov, 2022).

Lastly, the internationalization of civil service education programs in post-Soviet countries remains underdeveloped. While many of these countries aspire to align with European standards, their educational programs often lack sufficient exposure to international best practices and global perspectives on public administration (Ter-Matevosyan & Drnoian, 2020). Enhancing international cooperation through student exchange programs, inviting foreign experts as guest lecturers, and participating in international research projects can broaden the horizons of future civil servants. This exposure would not only improve their understanding of global governance issues but also foster innovation and new approaches to solving domestic challenges in public administration (Janenova, 2020).

In conclusion, the problems of training civil servants in post-Soviet higher educational institutions are multifaceted and deeply rooted in outdated systems and approaches. The main challenges include inconsistency between theoretical knowledge and practical skills, outdated curricula, lack of specialisation in educational programs, and insufficient adaptation to modern public administration needs. The solution to these issues requires a comprehensive reform of the educational system, involving not only changes in curricula and teaching methods but also modifications in the legal framework and organisational structure of civil service training. Moreover, the implementation of innovative programs, the introduction of practice-oriented learning, and the establishment of closer cooperation between educational institutions and government bodies are crucial steps towards improving the quality of civil servant education. By addressing these challenges, post-Soviet countries can significantly enhance the competence and effectiveness of their civil servants, ultimately leading to more efficient and responsive public administration systems that align with contemporary global standards and local needs.

CONCLUSIONS

As a result of the study, it was found that the current state of educational and methodological tools and

approaches in the universities of the post-Soviet space is unsatisfactory. So, many problems are both general and local, which indicates an extremely adverse impact of individual shortcomings on the educational system. The study analysed general educational issues at the highest level, which provoke many other contradictions. Among them, one can single out those shortcomings that are contained in general regulations, i.e., standards or orders of special state bodies. As for local issues, they are conditioned upon the specific features of the form of a particular state, as well as the type of university. Accordingly, in some of them, an important role is played by the method of financing the educational activities of students, as well as the distribution of specialties and qualification programs. Having systematically investigated each of them, one can unequivocally assure that the issues provoked by these issues are their inconsistency with modern requirements imposed not only on the educational process but also on civil servants.

A necessary condition for increasing the effectiveness of the implementation of educational and professional training of students is the modernisation of the entire

educational environment. This applies not only to particular educational and methodological plans and tools, but to approaches and understanding of the concept of civil servants, their essence, and their role in society. The implementation of the solutions established in this study allows for fully improving the quality of the acquired knowledge and skills of students, which will ultimately affect the activities of public authorities. Therewith, this subject is quite debatable and is subject to further consideration, especially in the context of the analysis of the latest programs and technologies for retraining and advanced training of civil servants and officials of local self-government, including in a remote format. A promising area for future research is the consideration of modern programs, including remote ones, to improve the professional competence of civil servants and name their main shortcomings.

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CONFLICT OF INTEREST

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Проблеми підготовки державних службовців у пострадянських вищих навчальних закладах

Анотація. Дослідження проблемних аспектів підготовки державних службовців у пострадянських країнах сьогодні є надзвичайно актуальним. Це, пов'язано з активною політикою перепідготовки кадрів за європейськими підходами. Таким чином, дослідження проблем, які наразі перешкоджають ефективному навчанню державних службовців, дозволяє знайти шляхи їх вирішення та вдосконалити. Виходячи з цього, метою даного дослідження був аналіз основних підходів та інструментів, що використовуються пострадянськими вищими навчальними закладами для підготовки державних службовців. Відповідно, для її досягнення було використано різні науково-методологічні засоби, зокрема функціональний та системний підходи, а також метод аналізу та синтезу, порівняння, дедукції та узагальнення. В результаті було висвітлено як теоретичну, так і практичну частину питання. У першій частині дослідження було визначено сутнісний зміст основних понять і термінів, пов'язаних з досліджуваною темою, а також висвітлено їх особливості. Крім того, було детально розглянуто методи та підходи, які є основоположними у підготовці державних службовців у пострадянських країнах, та показано їх основні недоліки. Дослідження виявило, що основними проблемами підготовки державних службовців у пострадянських вищих навчальних закладах є застарілі навчальні програми, недостатня практична підготовка, а також недостатній фокус на розвитку критичного мислення та лідерських навичок. Крім того, дослідження виявило необхідність більшого акценту на етиці, прозорості та підзвітності в освіті державних службовців. Нарешті, результати дослідження свідчать про те, що включення більшої кількості тематичних досліджень, симуляцій та стажувань могло б значно підвищити ефективність програм підготовки державних службовців у цих країнах. Практична цінність дослідження полягає в тому, що воно може бути використане як методичний матеріал для вищих навчальних закладів, так і для особистого розвитку окремих працівників освіти

Ключові слова: навчальний процес; компетентність; слухачі; модернізація; інноваційні технології

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Development and impact of stress on university students' performance during distance learning

Abstract. The study aimed to examine the relationship between stress and students' performance in distance learning. A sample of 50 participants was selected to evaluate their psychological state and stress levels using two methods: C. Spielberger's State-Trait Anxiety Inventory (adopted by Y. Khanin) and the V.Yu. Shcherbatykh's Test for Determining Educational Stress. The primary findings provided an interpretation of the concept of "psychological stress", its characteristics, causes, and consequences. During both in-person and distance learning, students experience a variety of emotional states, such as fear, anxiety, pessimism, depression, and aggression, which can serve as triggers for stress. The survey results revealed the level of stress experienced by students during distance learning, demonstrating its substantial impact on their performance, motivation, and overall effectiveness in the educational process. The study examined stress-inducing factors affecting higher education students under conditions of distance learning during the pandemic and following the onset of the full-scale invasion. It was highlighted that prolonged distance learning contributed to the development of chronic stress and resulted in social deprivation, particularly among first- and second-year university students. This led to a deterioration in students' psycho-emotional states, causing psychological imbalances. Under these circumstances, it is crucial to identify the specific features of students' psychological conditions. Academic stress was found to arise from an overwhelming influx of information, changes in learning conditions and formats, and the pressure of examinations. The analysis of stress symptoms revealed associations with intellectual, behavioural, emotional, and physiological components. The conclusions underscore the importance of timely stress management interventions for students and addressing challenges associated with transitioning to distance education. The findings can inform university administrations and lecturers in the development and improvement of student support programmes.

Keywords: higher education student; stress-inducing factors; experiences; distance education; academic performance

INTRODUCTION

Various psychological states give rise to different behavioural patterns, which can positively or negatively affect academic performance and overall life outcomes. Higher education students increasingly face diverse challenges stemming from the pandemic and the war, which have been pivotal factors in the widespread adoption of distance learning in Ukraine. The current educational environment under such conditions demands responsibility, autonomy, and self-organisation from all participants. Students must navigate contemporary challenges, adopt new roles, and adapt to changing life circumstances. However, these demands can adversely affect productivity due to stress.

Distance learning, which became particularly prevalent during the pandemic and after the onset of the full-scale invasion, has introduced new dimensions to the understanding of stress's impact on student performance. A primary stress factor is the isolation from peers and the absence of daily social interactions that typically provide emotional support. Furthermore, distance learning often blurs the boundary between personal life and academic responsibilities, leading to overload. Difficulties in achieving academic success within this learning format further exacerbate discomfort and increase overall stress levels. Living under constant stress also contributes to numerous

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health issues (Rogowska & Pavlova, 2023). Given the significance of the research topic, numerous academic studies have focused on distance learning, the influence of stress on students, and its impact on their academic performance in contemporary conditions. For instance, S. Grynyuk *et al.* (2022) argued that continuous education through alternative learning channels became a primary priority for institutions seeking to minimise the pandemic's effects on education. Most universities worldwide transitioned from regular in-person instruction to remote learning, necessitating changes to assessment tools and modes of communication between lecturers and students to address the challenges of the altered format. Building on this perspective, I. Hnatyshena *et al.* (2023) noted that distance learning has distinct features, shaping unique educational content structures, alternative teaching methods, and organisational strategies. This mode of education is increasingly adopted in global practice. Similarly, S. Yagelo *et al.* (2022) conducted a comparative analysis of distance and traditional learning under the conditions of martial law and the pandemic, identifying key criteria with the greatest influence on educational quality.

Many researchers have highlighted both the advantages and disadvantages of remote learning. Studies and experiments by leading education experts identified common features of distance education during the pandemic and other global challenges. These include accessibility, flexibility, growing popularity, ease of information exchange, and the use of interactive educational software (Kdyrova *et al.*, 2022; Boklan *et al.*, 2023; Yuan *et al.*, 2024).

Researchers I. Pondelíkova & T. Tökölyova (2022) examined the effects of the pandemic on individual productivity, as well as the digital identity of higher education lecturers. Their findings revealed that the shift to home-based education has caused exhaustion not only among students but also among lecturers. It was observed that lecturers and academic personnel are experiencing an unprecedented period of uncertainty in their professional roles. Psychological disorders that adversely affect learning and academic performance were investigated by O. Datsko *et al.* (2022). One of the prevalent issues identified was academic burnout, which significantly impacts students' motivation and desire to learn. An analysis of medical students highlighted their particular vulnerability due to the demands of their profession, with high levels of academic burnout, depression, anxiety, and stress being reported.

In a study by Z. Quraishi (2023), a decline in the mental health of higher education students was noted, alongside anxiety linked to misinformation and difficulties in addressing religious tensions. The global impact of the pandemic on students underscores the need for higher education institutions to adopt a more empathetic approach and explore innovative methods for improving learning systems under distance education conditions.

The findings of I. Cabelkova *et al.* (2022) highlight the importance of the emotional aspect of creativity in optimising behaviour among higher education students,

particularly concerning emotional experiences. When greater opportunities are provided to express all dimensions of emotional creativity, students demonstrate improved adaptation to challenging situations and may even leverage new opportunities. Most researchers have studied academic stress and productivity as separate issues, without establishing a direct relationship between them. Therefore, this study aimed to determine the correlation between academic productivity and stress resulting from distance learning. To achieve this aim, the following objectives were set:

- to examine the development of stress and its negative factors affecting students' mental health in the context of distance learning;
- to evaluate the academic performance of higher education students during distance learning;
- to develop recommendations for mitigating the negative effects of stress and enhancing productivity in distance learning contexts.

MATERIALS AND METHODS

The study employed theoretical methods to analyse, synthesise, and summarise scientific knowledge. These methods were aimed at formulating hypotheses regarding the development and impact of stress on the performance of higher education students during distance learning. The research utilised the following methodologies:

1. Questionnaire. An anonymous online questionnaire was administered, consisting of three main questions (an open-ended question "What challenges did you face during remote learning?"; a closed-ended question "Has your stress level changed over the past three months of study?" (response options: decreased/unchanged/increased), "What is your attitude towards distance learning?" (positive/neutral/negative). Additionally, the Test for Determining Educational Stress by V.Yu. Shcherbatykh was used.

2. The State-Trait Anxiety Inventory by C. Spielberger (adopted by Y. Khanin) (Educational grill, 2023).

The study was conducted over a two-month period (March-April) in 2024. The sample consisted of 50 students aged 18-21, spanning first- to fourth-year university students. The participants were divided into two main groups: first- and second-year students (25 respondents) and third- and fourth-year students (25 respondents). The sample included 21 female and 29 male participants. The survey adhered to the principles outlined in the Helsinki Declaration (2013), and all participants were informed about the intended use of the data they provided. The V.Yu. Shcherbatykh Test for Determining Educational Stress is designed to evaluate states of dissonance in stressful situations and track the dynamics of stress adaptation at various stages. The process began with a survey to identify the primary causes of stress based on three key indicators. Subsequently, the test presented a series of statements describing potential scenarios and emotions experienced by higher education students during distance learning. Respondents rated their experiences using the following scale: 1 – never

experience, 2 – rarely experience, 3 – sometimes experience, 4 – often experience, 5 – always experience. Interpretation of results: 20-35 points – low stress level; 36-50 points – moderate stress level; 51-75 points – high stress level; 76-100 points – very high stress level (Educational grill, 2023).

The State-Trait Anxiety Inventory by C. Spielberger (adopted by Y. Khanin) measures self-assessed anxiety, uniquely distinguishing between anxiety as a personal trait (trait anxiety) and as a temporary condition (state anxiety). This test can be conducted individually or in groups. Participants are asked to answer questions according to instructions in the questionnaire, working independently. The Spielberger methodology comprises a set of instructions and 40 items: 20 questions evaluate state anxiety (SA), and 20 questions assess trait anxiety (TA). The test consists of statements that determine the level of anxiety (Educational grill, 2023). Each question has four possible answers depending on the intensity. The test includes two response scales:

→ for the state anxiety scale: not at all (1), somewhat (2), moderately so (3), very much so (4).

→ for the trait anxiety scale: almost never (1), rarely (2), often (3), almost always (4).

Interpretation of results: 20-30 points – low anxiety; 31-45 points – moderate anxiety; 46-80 points – high anxiety.

RESULTS AND DISCUSSION

The field of higher education has undergone significant transformations due to the pandemic and the war. The pandemic forced higher education institutions globally to transition to distance learning, revealing both the advantages and significant challenges of this mode of education. On the one hand, distance learning offered flexibility and access to educational resources; on the other, it introduced issues such as inadequate technical support, difficulties with students' self-organisation, and social isolation. The war in Ukraine added a new dimension to these challenges, as students and lecturers were compelled to adapt to conditions of constant threat, displacement, and instability. Psychological stress from these events has profoundly affected students' productivity and mental health, necessitating new approaches within higher education to support learners and ensure the continuity of education in extreme circumstances. Stress presents several characteristics that indicate its presence and its impact on the learning process (Table 1).

Table 1. Key indicators of stress in academic activities

Indicator		Description
Emotional indicators	Increased anxiety	Students may experience persistent worry and anxiety, hindering their focus on the learning process
	Depression	Feelings of hopelessness, sadness, and a lack of interest in activities once enjoyed may indicate depression
	Aggressiveness	Heightened irritability, rapid mood swings, and aggressive behaviour can result from stress
Cognitive indicators	Concentration difficulties	Students struggle to focus on tasks, reducing learning effectiveness
	Memory impairment	The inability to recall information or forgetting critical details is a common symptom of stress-related cognitive decline
	Negative thinking	A tendency toward negative thoughts, pessimism, and self-criticism can hinder academic success
Physical indicators	Sleep disturbances	Sleep problems, such as insomnia or excessive drowsiness, are common signs of stress.
	Fatigue	Constant exhaustion, including headaches and migraines, even after adequate rest, may indicate high stress levels and complicate academic tasks
Behavioural indicators	Procrastination	Students frequently postpone tasks, leading to a backlog of work and heightened stress
	Decreased academic performance	Missed classes, declining grades, and uncompleted assignments are direct consequences of stress
	Social withdrawal	Avoiding social interactions, reducing participation in group projects, and refraining from communication with peers

Source: compiled by the author based on studies by I. Kdyrova *et al.* (2022), M. Boklan *et al.* (2023) and C. Yuan *et al.* (2024)

Stress adversely affects students' ability to learn effectively. It diminishes cognitive functions, making it more difficult to retain new information and complete complex tasks. Emotional strain during periods of stress can lead to reduced motivation, rendering the learning process less productive. Physical symptoms of stress, such as persistent fatigue and headaches, further reduce energy levels and readiness to engage in academic activities.

Psychological experiences of students under stress represent a state of mental tension triggered by environmental

factors perceived as threats or challenges. This state is associated with physiological, emotional, and behavioural responses, which often have detrimental effects on health and learning capacity. The distinct characteristics of psychological stress in higher education students include: high demands (the academic environment frequently imposes significant workloads, requiring the completion of assignments, preparation for examinations, and engagement in projects and research. This can create a constant sense of overload); transitional life stage (university years

often coincide with a period of intensive personal development, where individuals establish their identities, a process frequently accompanied by various crises); social changes (moving away from home, forming new social connections, and adapting to unfamiliar environments can provoke feelings of isolation or, conversely, overwhelm due to excessive social interactions); financial difficulties (many students face the challenge of self-sustaining their livelihood, adding another layer of stress).

According to the research by O. Sushchenko *et al.* (2022), the causes of psychological stress among higher education students include:

- academic pressure: factors such as remote learning, assessments, examinations, deadlines, and assignments exert substantial pressure on students;
- social relationships: conflicts with peers and lecturers, challenges in personal relationships, and feelings of loneliness;
- financial difficulties: limited scholarships, the need for part-time work, and financial debts;
- employment prospects: uncertainty about the future and fear of unemployment;
- personal issues: health problems and family conflicts.

The consequences of psychological stress stemming from these causes include: a decrease in academic performance, namely difficulties with concentration, reduced motivation to study, absenteeism; psychological problems, including anxiety, depression, and panic attacks. Physical (headaches, gastrointestinal disorders, decreased immunity) and social problems (isolation, problems in relationships with participants in the educational process) are possible in this case. Academic activity serves as the foundation of higher education institutions, requiring individuals who are both intellectually capable and emotionally resilient. For many students, academic pursuits are inherently stressful, particularly in the context of remote learning. Various levels of stress frequently accompany students from the onset of their studies, contributing to disruptions in affective, cognitive, and motivational functioning. According to the World Health Organisation, over 40% of illnesses are caused by stress-related situations. Academic activity dominates the student experience and is associated with significant stress levels. The primary cause of stress in this context is the importance attached to academic achievements and specific components of the learning process. Major life changes, such as transitioning to higher education, often induce stress, especially for first-year students. This phase is widely regarded as the most challenging in a student's academic journey, involving the acquisition of a new status, the formation of new relationships, and adaptation to unfamiliar environments. First-year studies are characterised as one of the most intellectually and emotionally demanding activities (Tsekhmister *et al.*, 2023). V. Shevchenko *et al.* (2024) identify significant life changes during this period as a primary source of stress for first-year students, noting that the transition to university life entails profound adjustments.

The rapid spread of the epidemic, which escalated into a global pandemic, severely affected public health systems, economic conditions, and social life worldwide. To curb the spread of the virus, many countries implemented stringent quarantine measures. As a result, students and lecturers were compelled to shift to remote work and learning formats within a short timeframe. This transition underscored the modern challenges associated with changes in the educational environment, particularly the integration of information and communication technologies (ICT) under quarantine restrictions. These shifts highlighted unique features and challenges of using remote learning formats in contemporary education.

The educational process mediated by information and communication technologies has become a defining feature of the academic landscape during the pandemic. The use of various technologies not only facilitates the transfer of traditional teaching methods to a remote format but also encourages the development of new approaches oriented towards independent learning. This shift has led to changes in the organisation of the educational process, the readiness of all participants to adapt to new formats, levels of digital literacy, and the ability to engage in self-directed and autonomous learning. These transformations, alongside unforeseen changes, have contributed to negative outcomes. Factors such as the accumulation of stress, limited living spaces, reduced extracurricular activities, and diminished interpersonal interactions, coupled with external isolation measures, have objectively complicated the situation.

In the context of the current wartime situation in Ukraine, remote education presents unique and complex stress-inducing factors for students. These challenges significantly affect their emotional, physical, and academic well-being. Stress has a notable impact on student productivity during remote learning for several reasons. Primarily, adapting to new learning conditions is inherently stressful. Many students face technical difficulties, such as unreliable internet connections or a lack of necessary equipment. These issues can lead to feelings of helplessness and anxiety, which undermine the ability to focus on academic tasks.

Social isolation associated with remote learning is another significant source of stress. The absence of in-person interaction with peers and lecturers can lead to feelings of loneliness and detachment. Social support is a critical component of emotional well-being, and its absence can result in depression and anxiety, both of which negatively affect learning capacity. Moreover, remote learning often disrupts students' daily routines. The lack of a clear daily structure can lead to difficulties in time management. Students may struggle to organise their schedules, resulting in feelings of being overwhelmed and stressed. The blurring of boundaries between study and personal time can also contribute to burnout. Increased academic workload during remote learning serves as another stressor. Students frequently face large volumes of assignments and strict deadlines, creating a sense of constant pressure.

Uncertainty about lecturers' expectations and assessment criteria further exacerbates stress, as students may not always understand what is required of them. These factors collectively impact the emotional and cognitive states of students. Stress diminishes concentration, impairs memory, and reduces attention, all of which contribute to declining academic performance. Students may procrastinate, lose motivation, and become less productive. Physical symptoms of stress, including headaches, sleep disturbances, and weakened immunity, further deteriorate overall health and hinder effective learning.

Stress during remote learning poses a significant challenge for higher education students. Its impact on productivity is evident in declining academic performance and

the deterioration of emotional and physical well-being. To substantiate this point, a study was conducted employing two methodologies. These involved a set of pre-designed, carefully selected, and validated questions aimed at assessing the psychological state and stress levels of students during remote learning. The questionnaires, designed for practical application, required no specialised equipment and were time-efficient for respondents to complete. This method was deemed the most suitable for examining students' psychological responses to stress in this context. The primary objective of the experimental study was to determine the overall situation, specifically stress levels and three key indicators derived from the survey. The results are summarised in Table 2.

Table 2. Survey results on stress levels during remote learning

No.	Stress factors	Response options from students	Group 1	Group 2
			Number of respondents	
1	Contribution of specific problematic situations to overall stress levels	Organisational issues: poor time management, lack of textbooks, financial constraints, etc.	20	7
		Persistent issues: irregular meals, academic workload, personal challenges, etc.	5	18
2	Changes in stress levels over the past three months of learning	Decreased	-	9
		Unchanged	17	10
		Increased	8	6
3	Attitudes towards remote learning	Positive	7	15
		Neutral	3	5
		Negative	15	5

Source: compiled by the author based on their own research

The analysis of the first indicator – the contribution of specific problems to the overall stress picture – revealed a moderate level of organisational issues and persistent challenges for the first group of students. This indicates the presence of numerous stressors affecting individuals pursuing higher education. The most apparent issues include first-year students' lack of behavioural skills, such as difficulty in organising their routines, financial constraints, heavy academic workloads, and strict lecturers. These challenges often stem from objective factors such as poor self-organisation, shyness, and irregular eating habits, all of which negatively affect their emotional well-being.

In the second group, organisational issues (e.g., lack of textbooks, inadequate time management, and financial limitations) highlight the ongoing adaptation of higher education institutions to new teaching methods and formats. For these students, persistent problems such as excessive academic workloads, improper nutrition, and personal life challenges were also prominent. However, they appeared better equipped to address these challenges independently, with minimal disruption to their studies. Over 60% of respondents in the first group reported an increase in stress levels, compared to 19% in the second group. In both groups, the majority did not observe significant changes in stress levels. However, a subset of respondents in the first group noted a stress reduction, whereas no such decrease was observed in the second group. In both cohorts,

some individuals experienced heightened stress, indicating the continued presence of stress-inducing factors in remote learning environments. According to the findings, third- and fourth-year students demonstrated a consistent reduction in stress levels, with 36% of respondents reporting such a decrease. These students relied on standard stress-management techniques. Conversely, first- and second-year students exhibited higher levels of anxiety. An analysis of students' attitudes towards remote learning revealed differing responses between the two groups. It is important to examine the characteristics and reasons for these attitudes in each group. Group 1 tended to have a more negative perception of remote learning, attributable to the following factors:

- adaptation difficulties (limited experience in higher education and insufficient time to adjust to university life; lack of essential technical skills and familiarity with online learning platforms);
- social isolation (absence of established social connections with peers and lecturers; reduced motivation due to a lack of social interaction);
- increased workload (a perceived sense of being overwhelmed by the growing volume of independent study);
- psychological stress (a heightened feeling of overload linked to the demands of self-directed learning).

These challenges adversely affected productivity through persistent stress and adaptation issues, leading

to a decline in academic performance due to difficulties in effectively organising the learning process. Group 2, on the other hand, exhibited a more positive attitude towards remote learning, supported by several factors: more experience and easier adaptation to the new format, favourable conditions for learning (a well-organised study space at home); utilisation of remote learning benefits (flexibility in scheduling, the ability to combine study with work, and savings in time and money on the way to the university); motivation and self-discipline; reduction of stress (no need to adapt to a new environment, less social stress from interaction in a large group). As a result, this group demonstrated higher productivity through effective organisation of their studies, lower stress levels, and improved academic outcomes, as they could focus more on their educational tasks.

Differences in students' attitudes towards remote learning can be attributed to various factors, such as year

of study, access to technology, personal traits, social circumstances, and the level of support provided by the university. These findings highlight the diversity in students' experiences with remote learning and stress levels, emphasising the importance of tailored approaches in supporting higher education students during remote education. The next stage of the study involved analysing and interpreting the obtained results. The V.Yu. Shcherbatykh Test for Determining Educational Stress facilitated the assessment of the extent to which higher education students experienced stress due to remote learning and its impact on their productivity, emotional state, physical health, and academic performance. The test consisted of a series of statements describing potential situations and emotions arising during learning, and the responses were recorded and evaluated using a corresponding scale. The results for both groups are presented in Table 3.

Table 3. Results of stress level analysis

Level of stress	Low	Moderate	High	Very high
	Number of respondents			
Group 1	10	7	3	5
Group 2	4	10	5	6

Source: compiled by the author based on their own research

According to the data in Table 3, 40% of first- and second-year university students (Group 1) reported no stress, while 28% experienced moderate stress. Among third- and fourth-year students (Group 2), 16% indicated low stress levels, and 40% reported moderate stress levels. These findings suggest a high level of stress resilience among respondents, as they demonstrate an ability to manage stressors and maintain effectiveness in stressful situations. However, 12% of Group 1 and 20% of Group 2 experienced high stress levels. These individuals might benefit from basic emotional self-regulation techniques to manage

stress. Training on stress management and mastery of both general and personalised coping strategies for addressing negative stress manifestations would be beneficial. Notably, 20% of respondents in Group 1 and 24% in Group 2 reported severe stress levels and required professional support for effective stress resolution. To further explore the hypothesis of high stress levels within the cohort, the authors employed the Spielberger-Khanin method, which evaluates anxiety through self-assessment. The results of anxiety analysis using the anxiety scales for Groups 1 and 2 are presented in Table 4.

Table 4. Results of the Spielberger State-Trait Anxiety Inventory (adopted by Y. Khanin)

Assessment of the level of trait anxiety				
	Low anxiety	Moderate anxiety	High anxiety	
	Number of respondents			
Group 1	5	7	13	
Group 2	12	8	5	
Assessment of the level of state anxiety				
Group 1	5	6	14	
Group 2	7	13	5	

Source: compiled by the author based on their own research

Qualitative analysis revealed that the majority of participants in Group 1 exhibited high anxiety and emotional instability. The study indicates that 54% of respondents demonstrated high levels of state anxiety, reflecting their response to various psychological stressors that adversely affect productivity, particularly under the conditions of remote learning. Stressors may manifest as reactions to negative evaluations, fear of being judged unfavourably, threats to self-esteem, or expectations of failure. Persistent

stress is characterised by an anticipatory fear of failure, which exacerbates the stress response.

A comparison of the two groups was conducted to identify the characteristics of stress and anxiety among first- to fourth-year students. The findings support the hypothesis that first- and second-year students are more sensitive to stress responses during remote learning compared to their third- and fourth-year counterparts. Students in these groups displayed differences in wellbeing,

activity, and mood levels. It was observed that the majority of students in Group 1 exhibited high anxiety (52%), coupled with emotional instability. Moderate anxiety was reported by 28% of the group, while 20% demonstrated low anxiety levels. In contrast, Group 2 showed only 20% experiencing high anxiety, with a notable 28% indicating low state anxiety. This suggests that students in Group 2 generally did not experience significant tension, worry, or nervousness. Additionally, third- and fourth-year students demonstrated lower stress levels compared to first- and second-year students.

First- and second-year students face greater stress due to the need to adapt to new academic and social environments, intense academic workloads, and a lack of experience in managing their educational processes. Students in their initial years often feel uncertain about their academic capabilities and worry about meeting the high standards of higher education. Furthermore, these individuals may harbour doubts about their choice of major and future career paths, contributing to additional stress. Over time, as students gain experience and confidence in their abilities, their stress levels typically decrease. This trend is evident among third- and fourth-year students, who tend to exhibit greater self-assurance. By this stage, they have established social connections and feel more secure within their social and academic environments.

A key component of successful learning is a student's ability to manage stress. This can involve various relaxation techniques, maintaining a healthy lifestyle, time management, and seeking support from a partner or professional psychologist. Stress management programs can be implemented in higher education institutions to help students develop resilience and maintain high academic achievement. As previously noted, mindfulness and meditation practices can be valuable for higher education students, especially first and second-year students. Meditation helps to calm the mind, reduce anxiety, and improve concentration. Mindfulness, a technique of awareness, allows students to stay in the moment, reducing stress and improving overall well-being. Breathing exercises are equally valuable: deep breathing (regular breathing exercises can reduce stress levels and promote relaxation), pranayama (yogic breathing techniques help regulate emotional state and improve concentration), and progressive muscle relaxation (this technique involves tensing and relaxing different muscle groups, helping to reduce physical tension and stress). According to the research results, stress during remote learning impacts students' academic performance through a complex influence on their emotional, cognitive, and physical states. Managing stress during studies and implementing effective support strategies can help students, especially first and second-year students, adapt to new conditions and maintain high levels of productivity.

The findings indicate that remote learning, which became particularly widespread during the pandemic and after the onset of full-scale invasion, introduced new dimensions to the issue of stress and its impact on higher

education students' performance. The results obtained regarding stress during the learning process, which can lead to decreased attention and concentration as stress can be distracting, making it difficult to focus on studies and complete tasks, align with the research of K.M. Al-Tkhayneh *et al.* (2023) and A.M. Rogowska *et al.* (2023). Additionally, as scientists note, memory impairment occurs. Memory can suffer under the influence of stress, making it difficult to memorise and reproduce material during exams and handouts. N. Byshevets *et al.* (2023) add to this list a decrease in productivity due to fatigue, namely, stress can lead to exhaustion. Poor sleep quality and decreased motivation are important aspects. Stress management and the development of resilience are key components that help students minimise the negative impact of stress on their academic success. Research results on the impact of stress on student performance show that stress impairs the ability to concentrate, reduces motivation, and worsens mental health, as it causes anxiety, depression, and emotional burnout, which further reduces productivity. It has been found that prolonged stress can lead to physical problems such as insomnia or chronic fatigue, which also reduces students' ability to learn effectively. Therefore, it is proven that high levels of stress have a significantly negative impact on students' academic performance, reducing their cognitive and emotional resources.

The results obtained support the assumptions of S. Caglar & C.B. Okuyan (2023) and R. Miroshnyk *et al.* (2022) that stress can have a significant impact on students during learning activities for various reasons. Stress can distract and reduce the ability to focus on the learning material. This can make it difficult to learn new information and understand complex concepts. In addition, stress can affect memory function, making it difficult to recall previously learned information and becoming an obstacle when taking tests or completing tasks that require memorisation of details. When all these factors combine, the learning process for students becomes more complex and requires additional support and stress management. The study results demonstrated that stress among students can manifest through various symptoms, including psychological distress, hopelessness, irritability, and detachment, often resulting from excessive physical or emotional strain caused by academic demands and related challenges. These findings align with the articles of S. Kalashchenko (2021) and O. Datsko *et al.* (2022).

It is crucial to acknowledge and address student stress, as it can negatively impact their learning, physical and emotional well-being, and overall quality of life. This hypothesis was confirmed by the research findings, which coincide with the conclusions of S. Derkach *et al.* (2022). However, it is important to note that a small amount of stress can have a positive impact on individuals, activating inner strength and ensuring proper bodily function. However, if stress becomes a significant part of life, it can have a profound impact on individuals and cause problems. Stress is a primary cause of many diseases, and constant exposure to

stressful situations can contribute to serious illnesses such as cancer, hypertension, and various cardiovascular diseases. Therefore, it is essential to study stress and productivity from various perspectives. The hypothesis regarding the correlation between academic performance and stress was confirmed by the research findings, aligning with the conclusions of P. Dlugosz *et al.* (2022) and O. Grytsiuk *et al.* (2022). The challenge with stress is that its symptoms can be expressed abnormally, suppressed, or not expressed at all. At the same time, stress is one of the most common causes of pain and failure in any individual, as modern life is characterised by constant pressures and emotions. Authors M. Fabian *et al.* (2024) support this idea and emphasise the information confirmed in this study, namely, that the consequence of stress almost always leads to excessive tension and reduced productivity, and only occasionally can lead to a positive outcome. In this context, the study identified two forms of stress: eustress and distress.

Due to individual personality traits, the experience of discomfort may depend on external stimuli and the personal characteristics of people experiencing a stressful situation: behavioural motivation, volitional qualities, self-control systems, and other characteristics. Physiological discomfort occurs when the nature of the activity or living conditions does not coincide with physiological needs (for example, in the presence of cold, noise, or heat, poor organisation of workplaces, there is a mismatch in the pace of activity), as studied by M. Goncharuk Khomyn *et al.* (2024). Psychological stress, as a unique set of mental states, is a distinctive form of reaction to excessive stimuli. The intensity of this reaction depends on how individuals perceive a particular factor or situation. According to O. Kokun & O. Bezverkhyi (2024), emotional stress is linked to the activation of cognitive processes, whereby individuals assess the level of threat posed to them and address the challenges encountered by comparing them to their own abilities.

C. Yuan *et al.* (2024) provide their own interpretation of the concept of "productivity", which aligns with the results of this study. They suggest that productivity is the result of a harmonious combination of planning, organisation, motivation, and time management. It is essential to develop these skills and take care of one's health to achieve high academic results and overall well-being, as stress significantly impacts productivity. Stress has long been an integral part of human existence. However, excessive pressure can lead to problems. Therefore, the challenge for modern individuals is to recognise the signs of stress and learn to suppress its symptoms to facilitate learning and other activities. The findings align with the research of Yu. Kuchyn & L. Lymar (2023) and I.K. Wardana *et al.* (2022), examined the factors influencing stress among students, highlighting their importance for several reasons. These include safeguarding students' health and well-being, enhancing the educational process, improving academic performance, and supporting social and economic welfare. Stress impacts not only individuals but also the broader social and economic well-being of society. Reducing stress among students can

facilitate their successful integration into the labour market and enhance productivity in their future lives.

The results provide a new perspective on the consequences of stress, as their analysis can offer insights into which aspects of education and the surrounding environment are stress-inducing and help develop strategies to mitigate these effects. Understanding how stress affects students can help identify ways to optimise the learning process. This includes creating a more supportive learning environment, adapting teaching and learning methods to meet students' needs, and developing stress management programs. Studying the impact of stress on students is key to creating a supportive learning environment and improving overall societal well-being.

CONCLUSIONS

The pandemic significantly altered the lives of university students, with remote learning emerging as a dominant change. One of the primary challenges associated with this shift is the heightened stress levels among students and its impact on academic performance. Remote learning can lead to feelings of isolation, a lack of motivation, and anxiety, all of which contribute to increased stress levels. Understanding the effects of stress during remote learning on university students and implementing measures to address it is crucial for ensuring academic success and overall well-being.

Theoretical analysis in this study defines stress as an inherent part of human life, representing a reaction to unstable conditions that disrupt emotional equilibrium. The causes of stress can vary widely, including personal life problems, professional, and academic pursuits. The educational process in higher education institutions directly affects mental and physical functioning, as well as overall well-being. Academic activities are considered to be the most emotionally demanding. Naturally, the workload for students, particularly during periods of remote learning, is notably high, significantly impacting productivity. According to the research findings, stress during remote learning affects the performance of higher education students through a complex influence on their emotional, cognitive, and physical states. Managing stress during studies and implementing effective support strategies can help students, especially first- and second-year students, adapt to new conditions and maintain high levels of productivity.

There are also differences in indicators of well-being, activity, and mood, as groups of varying ages and academic experience were identified. First- and second-year students exhibited higher levels of stress, activity, anxiety, and depression compared to third- and fourth-year students. This suggests that they are less adapted to the conditions of remote university learning. Students experience significant workloads during remote learning, which can lead to the development of fatigue. Under conditions of higher levels of stressful situations and stress itself in students, anxiety and depression are felt more acutely,

while mood and happiness levels are lower. Understanding these factors can help develop strategies to improve learning conditions and reduce student stress in remote learning environments, ultimately increasing their productivity. A limitation of the study was that not all students were willing to share personal information about their stress levels and productivity, which affected the representativeness of the results. Future research could involve a

larger number of students from various universities and countries to increase the generalisability of the findings.

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CONFLICT OF INTEREST

The author declare no conflict of interest.

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Розвиток та вплив стресу на продуктивність у студентів вищих навчальних закладів під час дистанційного навчання

Анотація. Метою статті було дослідження зв'язку між стресом і продуктивністю здобувачів освіти в умовах дистанційної освіти. Для дослідження психологічного стану і рівня стресу здобувачів освіти обрано групу осіб, кількість яких становила 50, та використано дві методики: тест на визначення рівня тривожності Ю. Ханіна, Ч. Спілберга та тест на навчальний стрес В. Ю. Щербатих. У основних результатах дослідження подано трактування поняття «психологічного стресу», його особливостей, причин і наслідків. У навчальному процесі під час очного та дистанційного навчання здобувачі освіти переживають різноманітні емоційні стани такі, як страх, тривога, песимізм, депресія та агресія, можуть діяти як тригери для виникнення стресу. Результати опитування здобувачів освіти дали змогу визначити рівень стресу під час дистанційного навчання, який мав значний вплив на їх продуктивність, мотиваційну складову та результативність у навчальному процесі. У дослідженні було висвітлено стресогенні чинники здобувачів вищої освіти в умовах дистанційного навчання у період пандемії та після початку повномасштабного вторгнення. У статті висвітлено, що тривале дистанційне навчання сприяло розвитку тривалого (хронічного) стресу і викликають позбавлення спілкування, зокрема у перших та другий курсів університету. Відповідно до цього у здобувачів відбувається погіршення психоемоційного стану, що призводить до психологічного дисбалансу. У цих умовах важливо виявити особливості психологічного стану здобувачів освіти. Навчальний стрес у здобувачів освіти формується через критичний потік інформації, зміни умов і форм навчання, здачу іспитів. Аналіз симптомів стресу був пов'язаний з його інтелектуальним компонентом, поведінковими факторами, емоційними факторами та фізіологічними змінами. У висновках важливість своєчасної корекції стресу у здобувачів освіти та вирішення проблем, пов'язаних із переходом на дистанційну форму навчання. Отримані результати можуть бути використані адміністрацією та викладачами закладів вищої освіти з метою розробки та покращення програм підтримки студентів

Ключові слова: здобувач вищої освіти; стресогенні чинники; переживання; дистанційна освіта; успішність

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Analysis of the effectiveness of modular training in the professional education of healthcare workers

Abstract. The study aimed to evaluate the effectiveness of modular training in the professional education system of healthcare workers, compared with traditional teaching methods. An experimental study was conducted involving 200 healthcare workers from various specialisations. The participants were divided into two groups: a control group (traditional training) and an experimental group (modular training). Knowledge and practical skills were assessed before and after the training using tests, surveys, and practical tasks. The findings demonstrated that participants in the experimental group, who were taught through the modular system, achieved significantly higher levels of theoretical knowledge and practical skills compared to those in the control group. Additionally, an increase in motivation for learning and independent study was observed among participants engaged in modular training. Modular training has proven to be more effective in preparing healthcare professionals compared to traditional teaching methods. The implementation of a modular approach can significantly enhance the quality of medical education and improve the professional competence of healthcare workers. The study highlighted the necessity of reforming the medical education system by adopting modular training. This approach facilitates a higher level of knowledge acquisition among healthcare professionals, which, in turn, improves the quality of medical services and contributes to the overall health of the population. The findings revealed that modular training is an essential tool in the professional education of future healthcare workers, as it ensures a deeper understanding of theoretical knowledge. This is evidenced by higher average test scores achieved in the study. The results can be utilised by lecturers in higher education institutions to improve the professional preparation of future specialists in the healthcare sector

Keywords: healthcare sector; future specialists; practical skills; professional development; educational technologies

INTRODUCTION

In the modern world, medical education is continuously evolving due to the rapid advancement of medical technologies and the growing demand for the professional training of healthcare personnel. One of the innovative approaches to education is the use of modular training, which structures the learning process to make it more flexible and

adaptable to students' needs. Modular training involves dividing the curriculum into distinct blocks or modules, each with its own objectives and tasks, promoting more effective material comprehension. The effectiveness of modular training in medical education lies in its ability to provide comprehensive professional preparation, focusing on

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developing practical skills and professional competencies. This approach enables students to gradually master complex medical disciplines by integrating theoretical knowledge with practical exercises. Such a method is particularly significant in medicine, where the quality of education directly impacts patients' health and lives.

A significant number of researchers have examined the effectiveness of modular training in the professional education of healthcare workers. For instance, N.O. Fedchyshyn *et al.* (2022) investigated the development of professional communicative competence among future healthcare professionals through the lens of language training. Their study emphasised the importance of communication skills for healthcare workers engaging with multicultural groups and patients from diverse cultural backgrounds. The findings demonstrated that integrating language education into professional training enhances patient understanding and improves communication in medical practice. Competency-based medical education faces numerous challenges, including resource shortages and insufficient funding. However, the adoption of new educational technologies and the integration of modern tools present opportunities for improvement. Research by L. ByrneDavis *et al.* (2024) analysed the challenges and opportunities of competency-based medical education in Bangladesh. Through interviews, observations, and mapping studies, the researchers explored ways to enhance the existing education system. The results highlighted issues such as resource scarcity, lack of funding, and limited opportunities for practical training. An innovative approach to addressing such challenges is the use of sensor-based modular training platforms to minimise vascular damage during endovascular surgery. These platforms incorporate various sensors that record and analyse surgeons' actions, refine techniques, and help prevent vascular injuries. N. Fischer *et al.* (2023) conducted a study focused on developing a modular training platform aimed at reducing vascular damage during endovascular procedures. The researchers designed and tested an advanced system that allows surgeons to practise complex operations without exposing patients to risk.

The use of 3D bioprinting in medical education opens new opportunities for training endovascular surgeons. This method enables the creation of realistic anatomical models, allowing complex procedures to be performed without posing risks to patients. R. Foresti *et al.* (2024) explored the application of 3D bioprinting in medical education, particularly in training endovascular surgeons. The researchers developed a modular system that utilises 3D bioprinting to create detailed anatomical models for educational purposes. Online modular training in eating disorder management, such as the PreparED programme, is a valuable tool for enhancing healthcare professionals' knowledge and skills in this area. This approach offers the flexibility to balance work commitments with learning, which is critical for effective material assimilation, as highlighted by O. Ruckbeil *et al.* (2022) and D.R. Glasofer *et al.* (2023).

The use of modular equipment, open-source software, and educational materials for training specialists in programmable logic controllers (PLCs) provides cost-effective and scalable learning solutions. This approach is particularly beneficial for countries and institutions with limited resources. H.P. Guntaka *et al.* (2022) analysed the use of modular hardware, open-source software, and educational content in PLC training. M. Hummel *et al.* (2024) examined the concept of stress and emotion management training for emergency service workers. The researchers reviewed existing programmes and approaches to identify the most effective training methods. Their findings indicated that implementing targeted educational programmes focused on stress and emotion management can significantly improve emergency service performance and reduce the risk of burnout.

Following a cross-sectional survey conducted among healthcare workers from 57 countries to assess their awareness and preparedness during the first wave of the COVID-19 pandemic, N.T. Huy *et al.* (2021) reported that many healthcare workers were inadequately prepared to operate effectively during a global crisis. The survey identified gaps in the knowledge and skills required for efficient pandemic response. The researchers recommended developing and implementing specialised training programmes to enhance healthcare workers' readiness for global emergencies. The modular training approach in this context has been shown to effectively improve the prevention and treatment of infectious diseases in public health facilities. Such an approach ensures that training programmes are tailored to the specific conditions and needs of each institution. E.M. Irungu *et al.* (2022) and H.D. Aleksandrenko & M.V. Shevchenko (2024) investigated the application of on-site modular training to enhance the quality of services related to infectious disease prevention and treatment in public health settings. These researchers designed and implemented programmes comprising various modules to train healthcare workers effectively. The use of mobile applications for healthcare worker training represents an innovative method that provides access to educational materials anytime, anywhere. This approach is particularly critical in primary care, where early disease detection can save lives. For instance, R. Jose *et al.* (2022) developed and implemented the M-OncoEd mobile application to train primary care physicians in cancer detection in India. This programme enables physicians to access learning resources flexibly, making training more effective. The purpose of this study was to determine the impact of modular training on the professional education outcomes of healthcare workers compared to traditional methods. To achieve this goal, the following objectives were undertaken:

- examining the theoretical foundations of modular training and its application in medical education;
- analysing existing training programmes for healthcare workers;
- conducting an empirical study to collect, analyse, and interpret data to evaluate the effectiveness of modular training in the professional preparation of healthcare workers.

MATERIALS AND METHODS

The research findings were analysed using statistical methods, including mean values and analysis of variance. This approach provided a comprehensive assessment of the impact of modular training on the education of healthcare workers. The methods and stages of the study employed for data collection, analysis, and interpretation are outlined below. The study was conducted at several medical education institutions in Ukraine, specifically Ivano-Frankivsk National Medical University and National Pirogov Memorial Medical University, Vinnytsya. The sample consisted of medical students, with a total of 200 respondents. Of these, 46% were male and 54% female, aged 22-23 years. Participants were divided into two groups: a control group (100 participants) receiving traditional education and an experimental group (100 participants) educated using modular training methods. An experimental study was carried out, involving a comparative analysis of the results between the two groups of medical students. The study lasted one academic year (2023-2024) and adhered to ethical standards and principles. All participants were informed about the purpose of the study and its voluntary nature. Confidentiality of respondents' personal information and anonymity of the collected data were ensured.

This study involved an analysis of documents, specifically the curricula and programmes of educational institutions, to evaluate the structure and content of modular training (specialisation 222 "Medicine", educational programme "Healthcare"). This method enabled the identification of key differences in educational approaches, highlighting the strengths and weaknesses of the modular system. It also provided insights into how theoretical knowledge and practical skills are integrated within the learning process. Based on the institutions' curricula, information regarding the outcomes of modular training implementation was gathered. This facilitated conclusions about its effectiveness and suitability in specific contexts. A comparative analysis followed as the next stage of the research. The performance of students trained using the modular system was compared with those educated through traditional methods. This comparison yielded objective data on the advantages and limitations of each educational system. The evaluation focused on several key indicators: the level of theoretical knowledge acquisition, practical skills, ability for independent thinking and decision-making, and overall readiness for professional practice.

The research procedure encompassed several stages. At the initial stage, all participants underwent testing, surveys, and practical tasks to establish their baseline knowledge and skills. During the study, the control group followed traditional instructional methods, while the experimental group utilised a modular system. This modular approach involved dividing the learning material into logically coherent units, emphasising active learning methods and independent work. The study focused on core modules, including human anatomy (examining the structure of the human body, its organs, and systems), physiology

(exploring the functioning of human organs and systems), biochemistry (studying chemical processes within living organisms), and pharmacology (analysing the effects of pharmaceuticals and their impact on the body). Upon completion of the training, all participants repeated the testing, surveys, and practical tasks to evaluate their acquired knowledge and skills. Assessment methods were applied at the beginning and end of the academic semester using various tools. Theoretical knowledge was measured through standardised tests comprising 50 questions on core medical disciplines. Satisfaction with the learning process and confidence in their knowledge and skills were assessed via questionnaires. Practical tasks, including specific medical procedures and simulations of clinical scenarios, were used to evaluate hands-on skills.

A variety of methods were employed to collect data, including an analysis of the curriculum for the Master's degree in "Medicine" (speciality 222) within the educational programme "Healthcare". This analysis aimed to evaluate the structure and content of modular learning. Document analysis provided insights into the organisation and content of the educational programmes, while a comparative analysis of student outcomes allowed conclusions to be drawn regarding the practical value of modular learning. These findings formed the basis for further recommendations to improve educational programmes and enhance the effectiveness of medical training. A questionnaire consisting of nine questions was utilised to assess participants' satisfaction with their education and confidence in their knowledge and skills:

1. How would you rate your overall satisfaction with the education provided at your institution?
2. How satisfied are you with the quality of learning materials and resources?
3. How would you assess the level of support provided by lecturers and administrative staff?
4. How confident are you in your knowledge of core academic disciplines?
5. Do you feel that the knowledge gained is sufficient for practical application in your future profession?
6. How would you evaluate your critical thinking and problem-solving skills?
7. Are you confident in your interpersonal communication and teamwork abilities?
8. Are you satisfied with the opportunities for practical training (internships, laboratory work, etc.)?
9. How confident are you in your ability to independently study new material and engage in self-development?

These questions facilitated the collection of detailed information about students' satisfaction with their education and confidence in their knowledge and skills, as well as identifying aspects of the educational process that require improvement. A comprehensive analysis was conducted of each aspect of the effectiveness of modular learning, particularly its impact on students' academic achievements, satisfaction with the learning process, and development of professional skills. Based on the findings,

recommendations were developed to enhance modular learning in the professional training of medical professionals. These recommendations include proposals for improving module structure, teaching methods, knowledge assessment, and feedback mechanisms.

RESULTS

Medical education has always required a high level of knowledge, skills, and practical competencies, improving teaching approaches a critically important task. Numerous researchers have focused on modular learning, which has demonstrated its effectiveness in many countries, including Ukraine. This approach enables the educational process to be more effectively tailored to the individual needs of

students while ensuring flexibility and a practical orientation. Modular learning involves dividing educational content into distinct blocks or modules, each covering a specific topic or set of topics. Typically, each module includes lectures, seminars, laboratory sessions, and independent student work. Modules are concluded with an assessment, which may take the form of tests, oral examinations, or practical tasks. This structure allows students to gain a deeper understanding of the material and immediately apply the acquired knowledge in practice. This approach incorporates essential features that make modular learning both effective and convenient for implementation across various educational institutions, particularly in higher education settings (Table 1).

Table 1. Functions of modular learning

Function	Subtype	Characteristics
Educational	In-depth material study	Modules enable students to focus on specific topics, facilitating deeper understanding and retention of knowledge. This is particularly crucial for technical and medical fields, where comprehensive knowledge is of critical importance
	Sequence and structure	The modular system provides a clear structure to the learning process, where each module logically follows the previous one, promoting the systematic assimilation of material
Organisational	Flexibility and adaptability	Modular learning allows the educational process to be easily adapted to the individual needs of students. They can complete modules at their own pace, enhancing learning efficiency
	Ease of planning	The clear structure of modules enables lecturers to better plan the educational process, accommodating the needs and abilities of students
Evaluative	Continuous knowledge assessment	Each module concludes with an assessment, such as a test, practical task, or oral examination. This enables regular evaluation of students' knowledge and identification of gaps in their learning
	Feedback	Regular evaluations provide feedback that helps students understand their strengths and weaknesses, enabling them to address any shortcomings effectively
Motivational	Intermediate achievements	Completing each module is accompanied by an assessment, which creates a sense of accomplishment and motivates students to continue learning
	Individual goals	The flexibility to choose the pace and order of modules allows students to set and achieve their own learning objectives
Practical	Application of knowledge	Each module incorporates practical tasks, enabling students to apply their knowledge in real-world scenarios. This is particularly important for medical and technical disciplines
	Preparation for professional practice	The practical orientation of modules prepares students for real-world professional settings, equipping them with the necessary skills and competencies
Communicative	Collaboration and discussion	Modular learning fosters active discussion and collaboration among students. Group projects and discussions enhance material comprehension and teamwork skills
	Interaction with lecturers	Regular feedback and discussions with lecturers improve material assimilation and allow for adjustments to the learning process

Source: compiled by the author based on studies by N.B. Salem *et al.* (2023) and T. Karatzias *et al.* (2023)

The advantages of modular learning include:

1. Individualised learning. Modular learning allows students to work at their own pace, which is particularly important in medical disciplines where the rate of material comprehension may vary among students. Each student has the opportunity to review and master the material fully before progressing to the next module.

2. Flexibility in the learning process. The modular approach enables students to plan their study time more effectively, allocating greater focus to topics they find challenging. This is especially beneficial for medical specialisations, where the workload is typically very high.

3. Practical orientation. Each module incorporates both theoretical and practical training. This ensures that students can apply their knowledge in practice, which is crucial for medical professionals. Laboratory work, simulations, and clinical placements enhance material retention and prepare students for real-world professional scenarios.

4. Assessment and feedback. Modular learning includes regular assessments of students' knowledge, allowing gaps to be quickly identified and the learning process adjusted accordingly. Feedback from lecturers helps students understand their mistakes and work on areas requiring improvement.

Despite its numerous advantages, modular learning presents certain challenges. Resource requirements: developing modular programmes demands substantial resources, both human and material. It is necessary to provide appropriate teaching materials, laboratory equipment, and highly qualified lecturers. Student adaptation to the new format: not all students adapt easily to the modular format. Many may struggle with the transition to self-directed learning and time management. Therefore, it is crucial to offer

support during the initial stages of the programme. Quality assurance in education: ensuring a high standard of the learning process is essential so that every student attains an appropriate level of training. This requires continuous monitoring and evaluation of both student performance and lecturer effectiveness. An analysis of various aspects of modular learning in higher medical education institutions is presented in Table 2, which highlights its effectiveness and identifies opportunities for improving the learning process.

Table 2. Characteristics of modular learning aspects in higher medical education institutions with specific examples

Aspect	Description	Examples
Learning structure	The learning process is divided into modules, each covering a specific topic or skill	The "Cardiology" module includes lectures, practical sessions, and independent research in cardiology
Teaching methodology	A combination of lectures, practical sessions, independent study, and interactive methods	Anatomy lectures are supplemented with laboratory work and online discussions
Knowledge assessment	Ongoing evaluations after each module and summative testing at the course's conclusion	Upon completing the "Pharmacology" module, students take a test and receive feedback
Practical sessions	Emphasis on practical skills, developed through laboratory exercises	Students practise resuscitation techniques on simulators during the "Emergency Medicine" module
Independent study	Students are assigned tasks for self-directed learning and preparation for classes	Students read supplementary materials and write essays on topics in the "Paediatrics" module
Flexibility	Modules can be adapted to individual student needs, enhancing the flexibility of learning	Students choose additional topics for in-depth study within the "Surgery" module
Interactive technologies	Use of electronic platforms, online courses, video lectures, and simulations	The online microbiology course features video lectures, interactive tests, and virtual laboratories
Student support	Consultations and guidance provided by lecturers throughout the learning process	Regular online consultations with lecturers in the "Infectious Diseases" module
Student motivation	Clear division of material into comprehensible modules enhances student motivation	Well-structured modules help students plan their studies and exam preparation effectively
Individualised approach	Tailoring learning to meet individual student needs	Students select topics for in-depth study in the "Therapy" and "Neurology" modules
Knowledge integration	Modules integrate theoretical knowledge with practical skills, ensuring a comprehensive approach	The "Gastroenterology" module combines lectures with clinical cases and practical tasks
Digital adaptation	Extensive use of digital tools and technologies to improve learning efficiency	The Moodle platform is used for real-time access to learning materials and assignments
Collaboration among students	Promoting teamwork and knowledge sharing among students	Group projects and discussions of clinical cases in the "Psychiatry" and "Dermatology" modules

Source: compiled by the author based on studies by A.I. Sevalnev *et al.* (2021), Z. Liu *et al.* (2024) and N. Kurian *et al.* (2024)

Existing training programmes for medical professionals encompass the evaluation of the content, teaching methods, and effectiveness of educational initiatives aimed at preparing healthcare personnel. This analysis includes several key aspects, namely the theoretical component, which involves assessing the level and relevance of theoretical knowledge provided within the curricula. Disciplines such as anatomy, physiology, pathology, pharmacology, and other foundational medical sciences are included in this component. The practical component involves an analysis of practical sessions, clinical placements, and internships, which enable students to acquire the essential skills required for working in real-world settings. Teaching methods are categorised into traditional, interactive, and online approaches. Traditional methods include lectures, seminars, and laboratory work used to deliver foundational knowledge. Interactive methods incorporate simulations, roleplaying, problem-based learning, and other active techniques designed to enhance material comprehension.

Online learning involves the use of digital platforms and resources to facilitate distance learning and self-directed study. This multifaceted approach ensures that medical training programmes comprehensively prepare students by combining theoretical knowledge with practical experience and diverse teaching methodologies.

The effectiveness of programs is evaluated based on several criteria. The first criterion is the assessment of knowledge and skills, which includes an analysis of assessment methods, such as tests, exams, and practical skills, such as clinical examinations and objective structured clinical examinations. The second criterion is adaptability to change, which determines how well programs adapt to the current demands of medical practice and scientific advancements. The third criterion is feedback, which includes an assessment of student and graduate feedback on the quality of education and their readiness for professional practice. Lecturers' preparation includes an evaluation of their qualifications and experience,

as well as their ability to conduct classes at a high level. Continuing professional development programmes for lecturers enable them to update their knowledge and enhance their teaching skills.

Infrastructure and resources are evaluated based on the availability of up-to-date textbooks, educational materials, and access to scientific databases. The compliance of laboratory equipment and clinical facilities with modern standards is also of critical importance. A comprehensive analysis of existing educational programmes for medical professionals highlights the strengths and weaknesses of the training process, identifying opportunities for improving the quality of education and adapting curricula to the current demands of the healthcare sector. The structure of modular components in medical education is defined by academic plans and programmes, including the allocation of study hours. For instance, the curriculum at Lviv National Medical University clearly delineates the time between theoretical and practical activities. Approximately 50% of the total study time is allocated to theoretical learning, while the remaining half is dedicated to practical activities, laboratory work, and clinical practice. The sequence of modules is structured to ensure that students begin with foundational modules in the early years of study, gradually progressing to more specialised and practice-oriented modules. This approach allows students to develop their knowledge and skills incrementally. Practical integration ensures that clinical practice is embedded within the curriculum from the third year onwards, enabling students to apply theoretical knowledge in real-world scenarios under the supervision of experienced medical professionals.

Modular learning is a contemporary approach to education that divides instructional material into distinct, logically complete modules. Each module focuses on a specific topic or skill and may include various teaching formats, such as lectures, practical sessions, independent study, and assessments. The process of modular learning is described below. The modular learning process involves the development of learning modules. Initially, the goals and learning outcomes for each module were defined. These goals were clear and specific so that students understood what was expected of them. Learning outcomes were defined in terms of specific knowledge and skills that students were expected to acquire upon completion of the module. After defining the goals and learning outcomes, the learning material was structured to provide a logical and sequential development of the topic. The content of the module was organised in the form of lectures, practical classes, independent work, and other learning resources. Lecturers prepared the necessary learning materials, such as presentations, notes, assignments, and literature for independent study. The learning process involved several stages. In the first stage, lecturers conducted lectures and seminars to introduce students to the basic concepts, theories, and information included in the module. Lectures were usually accompanied by multimedia materials that helped to better understand and remember information.

The subsequent stage involved practical sessions and laboratory work, enabling students to apply theoretical knowledge in a practical context. This stage is particularly critical in medical education, where hands-on practice is essential for preparing professionals. During practical sessions, students complete tasks simulating real-world scenarios they are likely to encounter in their professional practice. Independent study formed an integral part of modular learning. Students were assigned tasks for self-directed learning, designed to deepen their understanding of the material, develop research skills, and foster critical thinking. Lecturers provided guidance and support during this phase, ensuring a more effective learning experience. Knowledge and skills were assessed at every stage of the learning process. A variety of evaluation methods were employed, including tests, coursework, oral assessments, and practical exercises. These assessments allowed for the measurement of students' comprehension, identification of knowledge gaps, and timely adjustments to the learning process. The final stage of modular learning was the summative assessment, which involved a comprehensive evaluation of student's knowledge and skills across all completed modules. Summative assessment methods could include written exams, oral interviews, or the defence of coursework or dissertations. The outcomes of the summative assessment reflected the overall level of student preparedness and their readiness for professional practice.

The content of each module is designed to meet contemporary requirements for medical education and practice. The modules encompass both general subjects (such as anatomy and physiology) and specialised disciplines (such as surgery, internal medicine, and obstetrics and gynaecology). Universities employ a variety of teaching methods, including interactive lectures, seminars, practical sessions, simulation training, and group work, which actively engage students in the learning process. The assessment system includes regular testing, examinations, practical evaluations, and coursework. To effectively evaluate modular learning compared with traditional approaches, students were divided into two groups: a control group and an experimental group. Their knowledge and skills were assessed based on the following criteria:

1. Theoretical knowledge:

➤ The average test score in the control group before training was 60 points and 75 points after training.

➤ The average test score in the experimental group before training was 61 points and 85 points after training.

2. Level of satisfaction with learning:

➤ The percentage of satisfied students in the control group was 55% before training and 70% after training

➤ The percentage of satisfied students in the experimental group was 58% before training and 90% after training.

3. Practical skills:

➤ The average score for completing practical tasks in the control group was 65 points before training and 78 points after training.

→ The average score for completing practical tasks in the experimental group was 66 points before training and 88 points after training.

The experimental group demonstrated significantly better results compared to the control group, highlighting the effectiveness of modular learning in enhancing theoretical knowledge. Students who followed the modular methodology achieved a higher average post-training score, surpassing the control group by 10 points. The training for the Master's programme in the speciality 222 "Medicine", under the educational program "Health-care", at Ivano-Frankivsk National Medical University and National Pirogov Memorial Medical University, Vinnytsya, integrated theoretical and practical sessions within the modular learning framework. This approach ensured a comprehensive preparation for future doctors, emphasizing the gradual development of knowledge and practical skills. The training particularly focused on foundational disciplines, including anatomy, physiology, biochemistry, and histology. These courses equipped students with essential knowledge regarding the structure and functioning of the human body.

Key disciplines included pathology, pharmacology, microbiology, and immunology. Students studied pathological processes, mechanisms of drug action, the effects

of microorganisms, and immune responses. Additionally, specialised courses encompassed internal medicine, surgery, paediatrics, obstetrics and gynaecology, and psychiatry. These subjects covered a wide range of medical specialisations, deepening students' knowledge in specific areas of medicine. Practical training held a prominent role in the educational process, including laboratory work and clinical practice. Laboratory sessions involved conducting experimental studies in controlled settings to reinforce theoretical knowledge. Simulation-based training utilised simulation centres, allowing students to practise clinical skills in a safe environment. Students engaged with simulators replicating real medical scenarios. Clinical practice was conducted in hospitals and clinics under the supervision of experienced doctors. During these placements, students participated in the diagnosis, treatment, and care of patients, enabling them to apply theoretical knowledge in practical settings. Students enrolled in the modular system exhibited a higher level of satisfaction with the learning process. This could be attributed to the more interactive and practice-oriented approach of modular education, which facilitates better understanding and retention of material. The increase in satisfaction levels by 32% in the experimental group, compared to 15% in the control group, underscores the advantages of the modular approach (Table 3).

Table 3. Survey results for participants in the control and experimental groups

Question	Response options	Survey responses, %	
		Control group	Experimental group
1	<ul style="list-style-type: none"> - Very satisfied - Satisfied - Neutral - Dissatisfied - Very dissatisfied 	<ul style="list-style-type: none"> - 4% - 14% - 50% - 20% - 12% 	<ul style="list-style-type: none"> - 20% - 35% - 26% - 14% - 5%
2	<ul style="list-style-type: none"> - Very satisfied - Satisfied - Neutral - Dissatisfied - Very dissatisfied 	<ul style="list-style-type: none"> - 10% - 30% - 50% - 20% - 10% 	<ul style="list-style-type: none"> - 15% - 38% - 40% - 7% - 0%
3	<ul style="list-style-type: none"> - Excellent - Good - Satisfactory - Poor - Very poor 	<ul style="list-style-type: none"> - 16% - 14% - 45% - 10% - 15% 	<ul style="list-style-type: none"> - 45% - 14% - 16% - 15% - 10%
4	<ul style="list-style-type: none"> - Very confident - Confident - Neutral - Not very confident - Not at all confident 	<ul style="list-style-type: none"> - 10% - 25% - 40% - 15% - 10% 	<ul style="list-style-type: none"> - 40% - 25% - 20% - 15% - 0%
5	<ul style="list-style-type: none"> - Yes, completely - Yes, partially - Neutral - No, insufficiently - No, completely insufficient 	<ul style="list-style-type: none"> - 20% - 25% - 40% - 5% - 10% 	<ul style="list-style-type: none"> - 25% - 35% - 35% - 5% - 0%

Table 3. Continued

Question	Response options	Survey responses, %	
		Control group	Experimental group
6	- Excellent	- 15%	- 25%
	- Good	- 35%	- 35%
	- Satisfactory	- 40%	- 40%
	- Poor	- 0%	- 0%
	- Very poor	- 10%	- 0%
7	- Very confident	- 10%	- 45%
	- Confident	- 25%	- 14%
	- Neutral	- 40%	- 16%
	- Not very confident	- 15%	- 15%
	- Not at all confident	- 10%	- 10%
8	- Very satisfied	- 4%	- 15%
	- Satisfied	- 14%	- 38%
	- Neutral	- 50%	- 40%
	- Dissatisfied	- 20%	- 7%
	- Very dissatisfied	- 12%	- 0%
9	- Very confident	- 10%	- 20%
	- Confident	- 25%	- 35%
	- Neutral	- 40%	- 40%
	- Not very confident	- 15%	- 5%
	- Not at all confident	- 10%	- 0%

Source: compiled by the author based on their own research

The experimental group demonstrated significantly better performance in practical tasks, highlighting the advantages of modular learning in the development of practical skills. The 10-point difference between the control and experimental groups after training underscores the effectiveness of the modular approach in preparing students for practical applications. The findings of the study clearly indicate that modular learning is more effective than traditional methods in improving theoretical knowledge, student satisfaction, and the development of practical skills. This demonstrates the necessity of integrating modular approaches into educational processes to achieve superior outcomes in the training of medical professionals. Specifically, modular learning proves to be a more efficient method for preparing future medical specialists as it facilitates better assimilation of theoretical knowledge, enhances satisfaction with the learning process, and improves students' practical competencies. It is essential to implement modular learning in higher medical education institutions to elevate the quality of professional training. Based on the conducted research, the following recommendations can be proposed to optimise modular learning across various higher medical education institutions:

1. Integration of theoretical knowledge from various disciplines within a single module – develop integrated learning modules that combine content from anatomy, physiology, pharmacology, and clinical medicine. This approach enables students to recognise connections between different aspects of medical knowledge and practice;

2. Use of medical simulators for practical skills training – invest in modern simulation laboratories where students can practise skills on advanced mannequins replicating various clinical scenarios;

3. Problem-based learning with real clinical cases – incorporate real-world clinical cases into each module, requiring students to solve them independently or collaboratively, fostering critical thinking and clinical reasoning skills;

4. Implementation of flexible assessment methods – adopt a combination of formative assessments during the learning process (e.g., tests, mini-cases) and summative evaluations after module completion (e.g., comprehensive tests, practical exams);

5. Professional development for lecturers in innovative teaching and assessment methods – regularly conduct training sessions and workshops for lecturers to familiarise them;

6. Regular feedback provision to students on their progress – establish systems for frequent feedback where students receive detailed information on their achievements and areas for improvement through online platforms or individual meetings with lecturers;

7. Encouragement of active student involvement in research – create opportunities for student-led research by providing support and resources for their scientific projects within the modular curriculum.

An analysis of the results revealed that students trained under the modular system demonstrated a higher level of practical preparation and independence, which are critical attributes for medical professionals. At the same time, the traditional system exhibited certain advantages in the acquisition of theoretical knowledge. The use of these data collection methods facilitated a comprehensive evaluation of the effectiveness of modular learning. Enhancing modular education in higher medical institutions requires a multifaceted approach. This approach should integrate

innovative educational technologies, a combination of theoretical and practical knowledge, continuous professional development for lecturers, and active student engagement in the learning process. Such improvements are essential for preparing highly skilled medical professionals capable of working effectively in modern healthcare settings.

Modular learning stands out as one of the most promising methodologies in the professional training of medical personnel. Its effectiveness lies in the personalisation of education, allowing the creation of tailored learning pathways for each student. This is particularly important for medical professionals, as different specialisations demand varying levels of knowledge and skills. The modular system facilitates the adaptation of curricula to meet new requirements and standards, a necessity in the rapidly evolving fields of medical science and technology. Modern technologies, such as simulation training, virtual reality, and online courses, enhance student engagement and improve learning outcomes. Modules can focus on specific practical skills, ensuring that students are better prepared for real-world work in healthcare settings. Modular learning also supports the organisation of continuous professional development for medical professionals, a critical aspect of the healthcare sector. Its structure allows for interim assessments of students' knowledge and skills, enabling timely adjustments to the learning process. Key directions for the advancement of modular education include the development of new modules that incorporate recent medical advancements, the regular updating and refinement of existing modules, and the integration of innovative methods and technologies. These measures are essential for maximising the effectiveness of modular learning in the professional preparation of medical personnel.

The use of simulation training and virtual reality, alongside advanced technologies for modelling medical procedures and scenarios, enables students to practise skills in a safe and controlled environment. The integration of distance learning expands opportunities for remote education, allowing medical professionals from various regions and countries to participate in the learning process. Partnerships with medical institutions, including collaboration with clinics and hospitals, ensure students gain practical training in real healthcare settings. Regular training and professional development for lecturers working within the modular system are essential for implementing innovative methodologies and technologies. Modular learning holds significant potential for improving the quality of medical education, which, in turn, enhances the overall standard of healthcare services. To gain a clearer understanding of the topic, it is essential to compare the findings of this study with those of other researchers, evaluate the key advantages of modular learning, its impact on the professional training of healthcare workers, as well as the challenges and limitations educational institutions may face during its implementation.

Research has demonstrated that modular learning significantly enhances the efficiency of the educational

process, enabling students to focus on specific topics and acquire in-depth knowledge in each area. This aligns with the findings by N. Yuniarti *et al.* (2020), who noted that the modular approach facilitates better comprehension as students can study each module in greater detail. Furthermore, modular learning promotes the development of critical thinking and analytical skills, which are vital for medical professionals. One of the primary benefits of modular learning is its capacity to integrate theoretical knowledge with practical skills. The findings indicate that higher education students engaged in modular learning have greater opportunities for practical application, enabling better preparation for real-world work environments. This is corroborated by E.S. Kay *et al.* (2024), who highlight that modular learning increases student involvement in practical activities and enhances their readiness for clinical practice.

Modular learning provides flexibility in the educational process, allowing students to learn at their own pace and tailor the program to their needs. Results confirm that this approach allows students to better balance their studies with other commitments, which is especially important for medical professionals who often work while studying. Research by Y. Kopochynska *et al.* (2020) and M. Abdel-dayem *et al.* (2021) also highlights that the flexibility of modular learning increases student motivation and contributes to better learning outcomes. It is important to ensure flexibility in the educational process, allowing students to adapt the program to their needs and learn at their own pace. Research has shown that this approach increases student motivation and contributes to better learning outcomes. Despite numerous advantages, modular learning faces certain challenges and limitations. One of the main ones is the need to develop high-quality learning modules, which require significant effort and resources from educational institutions. This study has shown that creating effective modules requires the involvement of experts from various medical fields, which can be problematic for some educational institutions. This is consistent with the findings of the study by S. Machaca *et al.* (2022), who indicate the need for significant investment in the development of modular programs.

Another challenge is the need for ongoing monitoring and evaluation of the effectiveness of learning modules. Data from the current study shows that regular evaluation helps identify weaknesses in the modules and improve them. This is supported by research from J. Sessner *et al.* (2022) and C. Strowel *et al.* (2024), who emphasise the importance of feedback from students and lecturers for the continuous improvement of modular programs. It allows for the identification of weaknesses and problems in the learning process, providing an opportunity to address them promptly. Students can provide valuable information on how well they are learning the material and which aspects require additional attention. Lecturers can make suggestions for improving teaching methods and module structure. Regular analysis of feedback contributes to adapting programs to current needs and requirements,

increasing the effectiveness of learning. The research findings indicate that to successfully implement modular learning in the professional training of medical professionals, it is necessary to develop a strategic approach that includes several key elements:

1. Development of high-quality learning modules is fundamental to successful modular education. This involves engaging experts, employing modern methods and technologies, and ensuring the integration of theoretical knowledge with practical skills.

2. Organising professional development courses for lecturers to master the modular approach and contemporary teaching methods is a crucial component. Evidence confirms that such initiatives enhance the quality of the educational process and ensure alignment with current requirements.

3. Regular evaluation of module effectiveness enables the identification and rectification of weaknesses, facilitating continuous programme improvement (Malik *et al.*, 2023; Wegner *et al.*, 2023). This process helps pinpoint areas of the curriculum that require further attention or adjustment, thereby enhancing the quality of education and ensuring compliance with current standards. Lecturers can utilise evaluation results to refine teaching methodologies and learning approaches. Additionally, such evaluations encourage students to actively engage in the learning process, boosting their motivation and academic performance.

The prospects for the development of modular learning lie in the continued integration of advanced technologies such as simulations, virtual reality, and other digital tools, which can further enhance the educational process and the training of medical professionals. It is equally important to consider feedback from students and lecturers to continuously improve modules and adapt them to the evolving demands of medical practice. The findings of this study align with conclusions drawn by other researchers in this field. For instance, the study by P. Abril-Jiménez *et al.* (2022) demonstrated that modular learning enhances the training of medical professionals by enabling a more effective integration of theoretical knowledge with practical skills. Their conclusions are consistent with the present data, highlighting the significance of integrating theory and practice in the educational process.

Other research, notably the study of K. Lorey & J.M. Fegert (2021) and Q. Mansoor *et al.* (2024), strongly supports the importance of flexibility and individualisation in modular learning. Results confirm that the flexibility of the educational process increases student motivation and contributes to better learning outcomes. This is especially important for medical professionals who often work while studying. It is important to note that implementing modular learning requires careful planning and significant resources. It is necessary to ensure the development of high-quality learning modules, the professional development of lecturers, and the regular evaluation of program effectiveness. Collaboration between educational institutions, medical establishments, and other stakeholders is a crucial factor for success. Modular learning is an effective

method of professional training for medical professionals, allowing for the integration of theoretical knowledge with practical skills, providing flexibility and adaptability in the learning process. The results of this research, as well as other scientific studies, have shown that the modular approach contributes to better learning outcomes, increased student motivation, and their readiness for real-world work. However, to successfully implement modular learning, certain challenges must be overcome, including ensuring the development of high-quality learning modules, the professional development of lecturers, and the regular evaluation of program effectiveness. A strategic approach that includes developing high-quality modules, professional development, regular monitoring, and ensuring flexibility in the learning process is the key to the successful implementation of modular learning in the professional training of medical professionals.

In summary, modular learning offers many advantages for the professional training of medical professionals. It promotes a deeper understanding of the material, integrates theoretical knowledge with practical skills, and provides flexibility and individualisation in the learning process. This research, along with other scientific studies, confirms that modular learning increases the effectiveness and quality of training for future medical professionals, making them better prepared for real-world work.

CONCLUSIONS

Modular learning in higher education medical institutions provides a structured and effective approach to training medical professionals. The clear organisation of the learning process, integration of theoretical and practical classes, utilisation of modern teaching methods, and regular assessment contribute to a high quality of education. The modular learning system allows students to acquire in-depth knowledge and skills necessary for successful professional activity in the medical field. Modular learning ensures a deeper understanding of theoretical knowledge, as evidenced by higher average test scores. Students who study using modular methods demonstrate a higher level of satisfaction with the learning process, which may be attributed to the greater interactivity and practical orientation of the methodology. The modular approach significantly improves students' practical skills, which is critical for their future professional activities.

Overall, the research results confirm that modular learning is a more effective approach in the professional training of medical professionals compared to the traditional methodology. This indicates the need to implement modular approaches in the curricula of medical faculties to improve the quality of training for future healthcare professionals. Further research is needed to assess the long-term impact of modular learning on the professional activities of graduates of medical specialities. This will help determine the extent to which the acquired theoretical knowledge and practical skills contribute to the successful careers of medical professionals.

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CONFLICT OF INTEREST

None.

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Аналіз ефективності модульного навчання у професійній підготовці медичних працівників

Анотація. Метою дослідження була оцінка ефективності модульного навчання в системі професійної підготовки медичних працівників, у порівнянні з традиційними методами навчання. Було проведено експериментальне дослідження, в якому взяли участь 200 медичних працівників різних спеціальностей. Учасники були поділені на дві групи: контрольну (традиційне навчання) та експериментальну (модульне навчання). Оцінювання знань і практичних навичок проводилося до та після навчання за допомогою тестів, опитувань і практичних завдань. Результати дослідження показали, що учасники експериментальної групи, які навчалися за модульною системою, продемонстрували значно вищі показники засвоєння теоретичних знань і практичних навичок у порівнянні з контрольною групою. Також було відзначено підвищення мотивації до навчання та самостійного опрацювання матеріалу серед учасників модульного навчання. Модульне навчання виявилось більш ефективним у підготовці медичних працівників порівняно з традиційними методами навчання. Запровадження модульного підходу може суттєво покращити якість медичної освіти та підвищити рівень професійної підготовки медичних працівників. Дослідження підкреслило необхідність реформування системи медичної освіти з впровадженням модульного навчання. Це дає змогу підвищувати рівень знань медичних працівників, що в свою чергу покращить якість медичних послуг і сприятиме загальному покращенню здоров'я населення. Отримані результати дозволили виявити, що модульне навчання є необхідним інструментом у професійній підготовці майбутніх медичних працівників, бо забезпечує більш глибоке засвоєння теоретичних знань, що підтверджується вищими середніми балами тестів у дослідженні. Результати дослідження можуть бути використані викладачами закладів вищої освіти з метою удосконалення професійної підготовки майбутніх фахівців у сфері охорони здоров'я

Ключові слова: сфера охорони здоров'я; майбутні фахівці; практичні навички; підвищення кваліфікації; освітні технології

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Cultivating intercultural competency: The role of sustainability in pre-service teacher professional development

Abstract. Cultivating intercultural competency and sustainability within teacher training is essential for preparing educators to address the challenges of a rapidly changing world and to create inclusive, socially responsible, and environmentally conscious educational environments. The purpose of the present study was to examine the role of sustainability in pre-service teacher professional development and its influence on cultivating intercultural competency. In the study, two key methods to bring sustainability to the core of education strategy were used: an analytical method and a method of exploratory interviews as an instrument to collect data. The main ways of sustainable professional development of cultivating intercultural competency were continuing pedagogical practice, internal and external academic mobility, informal/non-formal education, and cooperation with stakeholders. The aforementioned activities were meticulously designed to provide a well-rounded professional experience for the pre-service teachers, facilitating their growth in the field of English teaching and fostering cultural understanding. The findings proved

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that the integration of targeted professional development initiatives significantly contributed to the enhancement of participants' capabilities and preparedness for their future roles as English teachers. The increased engagement observed underscores the practical relevance and applicability of the implemented strategies within language teacher preparation programs. The research results validated the theoretical frameworks, providing empirical support for the positive outcomes of professional development interventions in language teacher preparation programs. The observed improvements in linguistic and sociocultural dimensions underscore the programme's success in shaping proficient and culturally aware pre-service English teachers. The findings of the study can be used by higher education institutions that train future teachers, as well as organisations that implement professional development programs for teachers, in order to develop intercultural competence and introduce sustainability principles into the educational process

Keywords: preparation programme; pedagogical practice; internal and external academic mobility; informal/non-formal education; cooperation with stakeholders

INTRODUCTION

The modern field of education is undergoing significant changes, with an increasing focus on the concepts of sustainable development. In our increasingly interconnected society, it is more important than ever to develop intercultural competency among educators. The incorporation of sustainable development principles into education has gained traction as countries confront environmental concerns and the imperative for global citizenship. Within this particular environment, the advancement of pre-service English language teachers becomes a crucial domain for establishing enduring methods. These educators have a vital role in influencing the thinking of the next generation, and their ability to handle intercultural difficulties is quite important.

Effective professional development for teachers entails ongoing education that not only improves teaching skills but also adheres to the concepts of environmental, social, and economic sustainability. It surpasses brief training sessions and focuses on continuous development that enhances both personal and professional welfare. Simply having deep subject knowledge and practical skills is not enough for a modern teacher of any specialty. A 21st-century educator embodies intense spiritual life, a creative approach to pedagogical activities, and scientific research for innovative technologies that enable the successful achievement of educational goals while working with the children of a new generation.

Adapting the idea for upcoming English teachers, sustainable professional development entails training educators who possess both expertise in language education and the ability to incorporate sustainability principles into their teaching methods. This includes the promotion of multicultural comprehension, environmental accountability, and ethical discourse. Intercultural competency pertains to the aptitude to proficiently interact and involve oneself with others from a wide range of cultural backgrounds. It requires not just verbal competency but also a profound comprehension and admiration of diverse cultural norms, values, and views. Intercultural competency plays a vital role in promoting collaboration on global challenges within the framework of sustainable development.

The relationship between sustainable professional growth and the development of intercultural competency

is mutually beneficial. Interculturally-focused professional development programmes, which prioritise sustainability, equip prospective English teachers with the necessary expertise and abilities to effectively handle language and cultural variations. On the other hand, promoting intercultural competency becomes a crucial result of long-lasting professional growth as educators acquire the ability to assimilate varied viewpoints, encourage diversity, and integrate global matters into language teaching. This paradigm suggests that by incorporating sustainability principles into teacher development programmes, educators can improve their pedagogical skills and make a positive impact on sustainable development objectives, such as promoting intercultural competency. The interdependence of these notions emphasises the possibility of a mutually beneficial interaction where sustainable practices in teacher training work as catalysts for the development of intercultural competency, thereby enhancing the educational experience for both instructors and learners.

As noted by I. Žalėnienė & P. Pereira (2021), higher education institutions play a fundamental role in sustainability, serving as key agents in the education of future leaders who will contribute to the successful implementation of the United Nations Sustainable Development Goals. Higher education holds a distinctive position in spearheading efforts toward sustainable development. The sustainability promotion involves universities and colleges in endeavors such as promoting interdisciplinarity, adopting participatory pedagogies, conducting "real-world" research, and breaking down institutional boundaries. Several studies focused on higher education's role in implementing sustainability curricula, professional practices, and outreach activities in particular, the work by M. Weiss & M. Barth (2019). Other works, such as C.S. Seatter & K. Ceulemans (2017) and P. Hallinger & C. Chatpinyakoo (2019) have delved into challenges relating to implementing pedagogy teaching strategies for sustainability in higher education the influence of higher education institutions on sustainability, and the administration of educational programmes. Overall, institutions are often seen as "agents of change" in the advancement of sustainability, with sustainability-based education shaping both the content of the education and the related processes and outcomes (Gatti *et al.*, 2019).

The study aimed to explore the impact of sustainability on pre-service teacher professional development and its influence on intercultural competency development. The object of the research was the process of cultivating intercultural competency of pre-service teacher while the subject was the role of sustainability in pre-service teacher professional development and its influence on cultivating intercultural competency. The two research objectives guiding that inquiry were what participants' responses were to sustainability in pre-service teacher professional development in their teacher preparation programme and how sustainability in pre-service teacher professional development affected the intercultural competency development as EFL teachers.

LITERATURE REVIEW

The primary theoretical underpinning of this research is the Ecological Systems Theory, which was proposed by Bronfenbrenner (Soyer, 2019). This theory contends that interactions between various systems, ranging from the immediate microsystem to the larger macrosystem, have an impact on humans. Within the realm of pre-service teacher professional development, the ecological systems framework offers a perspective on how sustainable practices can spread across many levels of impact, ranging from the individual teacher to the institutional and social contexts. Sustainable development in education goes beyond the conventional emphasis on environmental preservation. This paradigm adopts a comprehensive approach that incorporates economic, social, and environmental aspects. Education serves as a catalyst for change, promoting a sense of global belonging, moral consciousness, and a dedication to the long-term welfare of society.

A significant block of work and reviews has explored the impacts and incorporation of sustainability principles in higher education establishments, including degrees, course contents, learning methodologies, inclusion and acknowledgment of sustainability issues in higher education (Fuertes-Camacho *et al.*, 2019; Sanchez-Carracedo *et al.*, 2021). In a study conducted by G. Tejedor *et al.* (2019), five key strategies for teaching sustainability in higher education were defined: project-oriented learning, simulation games, problem-based learning, service learning, and case studies. K. Mintz & T. Tal (2013) found that participatory learning methods result in higher learning outcomes compared to traditional lectures. Integrating sustainability principles into higher education institutions and their curricula enriches students' knowledge, perspectives, awareness, and attitudes towards sustainability. When sustainability principles are included in academic programmes and research, both university staff and students contribute actively to the goal of creating a sustainable world (Picatoste *et al.*, 2018). Several studies (Dmitrenko *et al.*, 2023; Svyrydiuk *et al.*, 2024) have observed that higher education plays a crucial role in enhancing students' skills, professional development, fostering entrepreneurship, and increasing their capacity to secure decent jobs. Higher education

institutions can significantly contribute to the achievement of sustainable development's targets by creating inclusive spaces and safe learning environments for various sensitive groups, including indigenous people, and individuals with disabilities (Dmitrenko & Voloshyna, 2018).

Threats to these processes are being recognised in numerous studies addressing obstacles of incorporating sustainability in higher educational institutions (Dyment & Hill, 2015). These challenges often originate from the conventional departmental and compartmentalised structure of universities, as well as their rigid disciplinary boundaries. The shift should extend to other aspects of professional practice that, instead of hindering, encourage interdisciplinary collaboration (Orlovic-Lovren, 2016). In attempts to reconcile the disparities between the conventional and innovative roles of universities, a number of researchers perceive the remedy found in enhancing teaching quality, thereby increasing substantial responsibility to the already complex and multifaceted role of teachers.

I. Franco *et al.* (2019) highlighted deficiencies in higher education regarding sustainable development policies, curricula, and practices across various continents. Key subjects, including integration problem-solving, anticipation skills, and systems thinking, should be embedded in all university curricula. An integrating approach should be the driving force behind the development of sustainability practices. These authors summarised the challenges associated with the implementation of Sustainable Development Goals. Key issues include: under-educated audience, ineffective and irrational learning methods, curriculum irrelevance, and motivational crises; a target audience that lacks awareness of global issues like climate change; consumption habits shaped by diverse cultures and environmental beliefs; social identity theory, which highlights individual perspectives; elitism and lack of diversity in educational and employment opportunities; and cognitive dissonance theory, where actions do not match beliefs.

Various authors have underscored the necessity of incorporating non-traditional facets of sustainability into the discourse. T.B. Ramos *et al.* (2015), for instance, highlighted the significance of delineating sustainability frontiers to encompass novel issues and paradigms in addition to traditional ones. Values play a pivotal role in shaping how academics respond to proposals for educating sustainable development and influencing the evolution of their disciplines. There is a call for a new generation of professionals capable of thinking and making decisions within this evolving perspective, necessitating the modernisation of educational frameworks for sustainability in higher education (Leal Filho *et al.*, 2015).

The shift in higher education towards sustainability should promote interdisciplinary and transdisciplinary approaches, blending theory with practice, fostering individual commitment and collaborative group actions, encouraging ethical discussions and reflections, and embracing critical thinking (Pepper & Wildy, 2008). Addressing these issues necessitates and drives innovation in

teaching methodologies (Brundiers & Wiek, 2017). Practice and theory integration can be realised in two main ways: fostering collaboration between universities and communities, and using the campus as a learning laboratory. Educators and students can apply the theoretical knowledge from their disciplines to address real-world projects. Moreover, involving students in dialogues with communities provides possibilities to acquire knowledge and comprehend various perspectives.

It is noteworthy to highlight that P. Bamber & L. Hankin (2011) have emphasised the significant transformative potential of student engagement through service-learning with local communities. This approach not only challenges students' stereotypes and personal values but also promotes their professional development (Sylenko, 2024). Comprehensive university approaches, integrating various activities such as teaching instruction, research, campus management, practice, and approaches meant to engage both community and stakeholder, have been identified as fundamental incorporating sustainability in higher education institutions (Jokikokko & Uitto, 2017). While many universities traditionally believe that students acquire theoretical knowledge on campus and are supposed to seek practical experience elsewhere, the initial exposure to hands-on experience can definitely be realised within the university environment. M. Louren & A.I. Andrade (2018) investigated strategies through which teacher education programmes can equip student teachers to incorporate sustainable concepts and practices into their teaching development.

Professional development is a broad term that encompasses various learning experiences, which can include anything: from single workshops to extensive curricula and communities of practice. These initiatives focus on the education, training, and development of professionals, with the ultimate goal of enhancing students' developmental and educational outcomes. Professional development is an ongoing and lifelong learning process for teachers, necessitating continuous updates to their methods, particularly when dealing with multiethnic classes (Biasutti *et al.*, 2019). These advancement practices should shape pre-service teachers' knowledge, practical skills, and the formation of their professional identities, including their beliefs, values, and attitudes towards classroom teaching activities (Syahrin *et al.*, 2023). Encouraging teachers to reflect on their attitudes (Tejedor *et al.*, 2019) and engaging in discussions and negotiations within a professional community facing similar challenges are significant aspects of this process (Romijn *et al.*, 2021).

Intercultural competency pertains to the capacity to effectively communicate with individuals from diverse cultural backgrounds by leveraging one's intercultural knowledge, skills, and attitudes. Intercultural competency is characterised as a developmental process aimed at achieving proficiency in interacting with cultural diversity, encompassing "effective and appropriate behavior and communication in intercultural situations" (Ovcharuk *et*

al., 2020). The cultivation of intercultural competency is essential for educators aiming to be globally competent, emphasising the significance of integrating such preparation within teacher education. The intercultural framework developed aligns with the OECD's definition of global competencies, which entails the capacity to analyse local, global, and intercultural issues, appreciating and valuing diverse perspectives and worldviews. It highlights the importance of engaging in open and constructive dialogue with individuals from various cultures and taking action for collective well-being and sustainable development. Intercultural education promotes cultural exchanges, fostering democratic and peaceful coexistence among people. Becoming intercultural individuals involves developing responsible attitudes toward sustainable citizenship (Kalinina & Prokopchuk, 2023).

In the face of contemporary societal challenges, teachers are required to navigate the multicultural environment. They need to be prepared to introduce innovative methods of learning, communication, and investigation to their students. This approach aims to prepare pre-service teachers for the labor market, entrepreneurship, and citizenship. To foster the sustainable professional development of pre-service teachers of English in the educational process, it is important to provide it in multilevel quasi-professional activities of students. Recognising and valuing the diversity among students is essential for creating an inclusive and effective educational space (Dmitrenko & Voloshyna, 2018).

In summary, the literature underscores the critical role of sustainability in higher education, emphasising the need for interdisciplinary collaboration, practical application, and continuous professional development. The integration of sustainability principles into curricula not only enriches students' knowledge and skills but also fosters their global and intercultural competencies. Moreover, professional development initiatives equip pre-service teachers with the necessary strategies to navigate diverse educational environments and address contemporary challenges. By blending theory with hands-on experiences, universities can cultivate a new generation of educators who are both socially responsible and professionally competent, ensuring meaningful contributions to sustainable development in education.

MATERIALS AND METHODS

The analytical method provided the analysis of the current scientific research and practices including Ukrainian and world experience of the pre-service teacher professional development as well as finding the ways of enlarging pre-service teacher's professional competency at the level of intercultural competency. The analytical method was based on the availability of data that gave the possibility to create a framework for measurement of the level of pre-service teacher's professional competency. This research employed *the qualitative case study* to cultivate intercultural competency in Ukrainian university students. The study adopted a qualitative case study approach, using a *method of exploratory interviews* as an instrument to

collect data. To clarify the role of sustainability in pre-service teacher within their teacher preparation programmes, a questionnaire containing 10 statements with “Yes”, “No” answer options including “Do you understand the notion of the phrase “sustainability in professional training?”; “Are you satisfied with the sustainability in your pre-service teacher programme preparation?”; “Do you approve of the organization of practice in your university?”; “Do you feel more confident and independent having different practice as the part of your teacher training programmes?”; “Can you find the problem for your research as a part of sustainability in the pre-service teacher training and define its difficulties and milestones?”; “Do you feel confident selecting proper sociocultural material, teaching tools and activities for pupils of different school age?”; “Are you satisfied with the results of your sustainable teacher training programme at the university?”; “Are you positive about the level of internal and external academic mobility in your university?” were developed.

All ethical standards specified in the Declaration of Helsinki (2013) were observed and followed during the study. The research was organised during April, 2022 – December, 2023. It should be noted that 86.3% of respondents

who participated in the research were in Ukraine at that time, and 13.7% lived abroad, mostly in Europe (the UK, France, Portugal, Spain, and other countries) as they had to leave Ukraine because of the Russian-Ukraine war. Their age range was between 18 and 21 years. All participants had graduated in the subject “The Methodology of Teaching English” and “The Methodology of Teaching Foreign Literature”. The participants of the present studies included pre-service teachers (N = 150) who were learning English at different higher education institutions of Ukraine (N = 3) (i.e., Mariupol State University (50 participants), Zhytomyr Ivan Franko State University (70 participants), and Hryhorii Skovoroda University in Pereiaslav (30 participants). All of the participants completed the questionnaire and nine students agreed to give an unstructured informal interview. They were juniors and seniors at Bachelor’s degree (Table 1). The participants were all Ukrainian natives but they were with different levels of education and professional activity. For this reason, they were required to obtain a higher level of English language competency and cultivate intercultural competency. Before the assessment of the students’ proficiency they were told it would be on a voluntary basis and the interview wouldn’t affect their results.

Table 1. Participant Relevant Information

University	Number of Participants			Completed Questionnaires	Interviews	Year of Study	
	Home located	Internally displaced	Externally displaced			1-2 year	3-4 year
Mariupol State University	0	20	30	50	3	15	35
Zhytomyr Ivan Franko State University	30	10	30	70	4	20	50
Hryhorii Skovoroda University in Pereiaslav	15	7	8	30	2	10	20
Total	45	37	68	150	9	45	105

Source: compiled by the authors

The main ways of sustainable professional development of cultivating intercultural competency were continuing pedagogical practice, internal and external academic mobility, informal/non-formal education, and cooperation with stakeholders. At the end of the research, a questionnaire and an unstructured informal interview were conducted to gather information connected with the research questions. Instructors from three universities, who had integrated four main ways of cultivating intercultural competency, were incorporating sustainability in teacher professional development with their pre-service teachers. At the conclusion of training, a dedicated 60 minutes were allocated for interviewing nine participants, who expressed their opinions on the expediency of applying sustainability in pre-service teacher professional development and its influence on cultivating intercultural competency. During these interviews, instructors from the participating universities communicated with pre-service teachers to learn their attitude. On the basis of the obtained information the instructors designed the collaborative online platform to

unify the results and accept a common point of view, the role of sustainability in pre-service teacher professional development and its influence on cultivating intercultural competency. Furthermore, instructors systematically were collecting the pre-service teachers’ outcomes, such as reflection essays, observation journals, e-portfolios, course certificates, etc. Such practice of data collection not only facilitated the assessment of individual progress but also enriched the collective understanding of the outcomes achieved through the incorporation of sustainability in pre-service teacher professional development and its influence on cultivating intercultural competency.

For thorough analysis of the obtained data its key patterns were identified by multiple scanning, interview scripts were added to the research questions, and conclusions of its validity were drawn. For this purpose, verification strategies were used, namely, each of the instructors analysed the obtained findings individually and with other instructors to check and validate that the results were precise. This method made the instructors certain of the

results they have got, which stressed the role of sustainability in pre-service teacher professional development and its influence on cultivating intercultural competency.

RESULTS AND DISCUSSION

As essential aspect of fostering intercultural competency in education is integrating diverse strategies that enhance students' cultural awareness, adaptability, open-mindedness, empathy, and communication skills, so that must be a multifaceted approach that integrates different experiences. In the study, four main ways of cultivating intercultural competency were implemented in the educational process: continuing pedagogical practice; internal and external academic mobility; informal and non-formal education; cooperation with stakeholders. These approaches reflected the increasing importance of sustainability in teacher education, particularly in the context of global challenges and ongoing transformations in the educational landscape. The description of four main ways of cultivating intercultural competency highlighted how these methods contribute to building a more inclusive, innovative, and resilient educational framework, particularly in the Ukrainian context, where teachers must navigate the complexities of war, displacement, and educational reform.

1) Continuing pedagogical practice. To make access to continuing pedagogical practice is the priority task to guarantee sustainable development in education. The ways of realisation of continuing pedagogical practice are getting more and more complicated. Many high schools have mixed or online forms of education. Pre-service teachers must adapt to learn and teach under the conditions of the state of war. The new generation of teachers ensures holistic pedagogies by finding ways forward in teaching and learning.

2) Internal and external academic mobility. The internal and external academic mobility is carried out within the framework of the bilateral University cooperation agreements. This cooperation became a good practice at Hryhorii Skovoroda University in Pereiaslav, Mykhailo Kotsiubynsky Vinnytsia State Pedagogical University, Zhytomyr Ivan Franko State University and others. In 2023-2024 the

students of the Ukrainian and Foreign Philology Faculty (Hryhorii Skovoroda University in Pereiaslav) attended the courses of lectures and completed practical assignments in Ternopil Volodymyr Hnatiuk National Pedagogical University and Sumy A.S. Makarenko State Pedagogical University. External academic mobility has a great impact on sustainability in education. Students acquire international experience and form intercultural competency by studying in a foreign country. The student mobility groups were created at Hryhorii Skovoroda University in Pereiaslav to go to the University of West Bohemia in 2017. The students had the chance not only to study but also to travel around the Czech Republic and beyond. Neither the COVID-19 pandemic nor full-scale war has stopped this project.

3) Informal and non-formal education. Informal and Non-Formal Education is a part of holistic sustainability education. As practice shows, during the war pre-service teachers join many teachers' associations. For pre-service English teachers in Ukraine, the most popular of them are IATEFL (based in Britain) and TESOL (based in the USA). Webinars, conferences, conventions, meetings and workshops allow the pre-service teachers to know the latest trends in the education field, take part in interactive workshops, and enter into debates about sustainable development issues in theory and practice.

4) Cooperation with stakeholders. University cooperation with stakeholders provides guidelines and metrics for students to orient on the labor market. The universities and stakeholders must build sustainability systems of cooperation. The importance of cooperation with stakeholders is evident because of the necessity of postwar recovery.

The methods and four ways mentioned above enabled a holistic understanding of the interplay between sustainability in pre-service teacher professional development and cultivating intercultural competency, contributing to nuanced insights into challenges and successes in the studied context. Subsequently, 150 students of Mariupol State University, Zhytomyr Ivan Franko State University, and Hryhorii Skovoroda University in Pereiaslav, who participated in the research, were asked to respond to questionnaire statements and comment on some of their answers (Table 2).

Table 2. The questionnaire: "The role of sustainability in pre-service teacher professional development in their teacher preparation programme"

№	Questionnaire Statements	Yes		No	
		N	%	N	%
1.	Do you understand the notion of the phrase "sustainability in professional training"?	144	96	6	4
2.	Are you satisfied with the sustainability in your pre-service teacher programme preparation?	138	92	12	8
3.	Do you approve of the organisation of practice in your university?	123	82	27	18
4.	Do you feel more confident and independent having different practice as the part of your teacher training?	114	76	36	24
5.	Can you find the problem for your research as a part of sustainability in the pre-service teacher training and define its difficulties and milestones?	96	64	54	36
6.	Do you feel confident selecting proper sociocultural material, teaching tools and activities for pupils of different school age?	114	76	36	24
7.	Are you satisfied with the results of your sustainable teacher training programme at the university?	123	82	27	18
8.	Are you positive about the level of internal and external academic mobility in your university?	128	85	22	15

Source: compiled by the authors

On the whole, 92% of the respondents were positive about the sustainability of their pre-service teacher programme preparation. They spoke in favor of the interactive workshops which enabled them to share their experience with other students, to compare their points of view and to express their attitude towards the actual methodological problems studied. Moreover, more than 76% of students approved of organising different kinds of professionally oriented practice with increasing the portion of pre-service teachers' independence as a characteristic trait of sustainability. Thus, it started with observation practice, then teacher assistantship practice, then guided language and methodological practice and finally independent practice at school. The respondents claimed that such practice allowed them to observe foreign language teaching in real pedagogical situations, to try their hand at doing microteaching.

Students learnt to skillfully conduct observations: analyse, compare, logically link teaching methods and issues, process results, and formulate conclusions in the form of their generalised conclusions (Kalinina & Prokopchuk, 2023). Yuliia, the third-year student, explained: "I liked observation practice a lot because it allowed me to see sustainability in practice better than our discussions in class workshops found reflection in teaching. For me, it's a great showcase of theory and practice". Nazar, the fourth-year student, supported her idea saying "Such kind of practice, especially teacher assistantship, enabled me not only to learn a lot from school teachers but also to avoid methodological mistakes in my independent practice at school". The most important thing is that I believed in my teaching abilities". Besides, each module of the teacher training programme was focused on the development of students' cultural awareness. For example, in the workshops which touched upon the problems of spoken production and interaction, students analysed the cultural manifestation of culture in the English language and compared them with those of the mother tongue.

One of the questions dealt with the ability of learners to find the problem for their research as a part of sustainability in their pre-service teacher training. Importantly, more than half of the students (64%) defined the difficulties of different ages of schoolchildren learning English and decided to research the problem to find some techniques and strategies that might be effective for school children. The results of the findings were presented either at the annual students' scientific conferences by publishing the findings of the research or writing and defending their action research. Given blended learning and due to online learning the students got the possibility of internal mobility as a part of their professional training. One of the latest examples was the online pedagogical tandem of fourth-year students who had just completed their independent school practice. The students of all the universities mentioned appreciated the use of that form of teacher training as they could share information about their insights into profession. 76% of students confirmed that school learners evinced great interest in sociocultural material and teaching

tools as well as activities based on intercultural issues. Mostly, it concerned senior learners who had their own experience communicating with representatives of other cultures. The majority of the students (82%) also expressed their delight at sharing their experience and were satisfied with the results of their sustainable teacher training programme at the universities.

As for the university practice supervisors, they also admitted the benefits of a 3-year sustained pre-service teacher training. All of them agreed that the pre-service teachers they were supervising, demonstrated not only highly developed and thoroughly chosen classroom English but also their professionally oriented teaching skills, the use of innovative techniques and digital tools. The obtained study results were consistent with previous research, for example: a positive link between higher education and sustainable development was emphasised contributing to graduates obtaining well-paid jobs and fostering stable, prosperous societies (Fehlner, 2019); the importance of embracing interpretive flexibility and accommodating variations in practices had been emphasised as crucial for integrating sustainability development into the university context (Tejedor *et al.*, 2019; Sanchez-Carracedo *et al.*, 2021). W. Leal Filho *et al.* (2015) proved that higher education institutions played a key role in implementing education for sustainability through various facets: teaching and research centers where institutions can promote sustainability by initiating projects and integrating sustainable practices; influence through outreach activities: the practices implemented by educators could have a wider impact by influencing public opinions through outreach activities; cultural impact: the establishment of an institutional culture of sustainability increased awareness among university staff and the local and broader communities; formation of professionals: higher education institutions bore the responsibility of shaping the future specialists who would play a leading role in various professional settings and social activities. By implementing sustainable practices on campuses, such as reducing greenhouse gas emissions, promoting the variety of fauna and flora, and using energy efficiently, institutions could lead by inspiring their members.

The results of the research confirmed the theoretical frameworks presented in the analysed sources. For example, the works by O. Ovcharuk *et al.* (2020) showcased instances of commendable techniques to use in the effort to transform universities towards sustainability and insisted on viewing the campus as a means of developing students' environmental awareness. Universities ought to function as laboratories for experimenting with sustainable behaviors. Sustainability of any university showcases its environmental policy.

Concerning the 2nd question: "How did sustainability in pre-service teacher professional development affect the intercultural competency development as EFL teachers?" nine students who were parallelly studying at the above-mentioned universities and higher educational institutions in Europe and the USA were interviewed. The aim was to determine whether a sufficient level of

professional training, including their sociocultural competency development, had been provided to them at their universities in Ukraine. One of them, Valeriia, said she felt comfortable in France and due to her sociocultural competency she managed to avoid sociocultural shock. Moreover, the student focused on her ability to participate in the dialogue of culture freely with students with different cultural backgrounds which spoke of her cultural awareness. The other student, Nastya, who studied at York University in Britain responded that thanks to her sustained teacher preparation programme in Ukraine she could cope with all the tasks and generally didn't face difficulties communicating with native speakers. Nevertheless, the student admitted that at times she lacked confidence in choosing correct verbal or non-verbal communicative behavior patterns in some situations of non-academic spheres. Overall, all the students interviewed said they succeeded in their professional and sociocultural competency development due to the sustained pre-service teacher development programmes at their universities.

The obtained study results accorded with the framework proposed by S. Syahrin *et al.* (2023), where intercultural competencies comprised all components which were interconnected and mutually reinforced. Knowledge encompassed understanding oneself by means of intercultural communication as well as broader awareness of the world (e.g., politics, law, human rights, cultures, religion). Skills crucial for intercultural competencies include listening and observing, cooperation and problem solving skills. The model also highlights the importance of developing analytical and critical thinking skills as essential skills for reflecting on personal biases. Finally, intercultural competencies involve actions aimed at promoting learners general well-being and sustainable development, on both local and global scales (Romijn *et al.*, 2021).

The results derived from both qualitative and quantitative analyses of the conducted research unequivocally affirmed the effectiveness of professional development within language teacher preparation programmes. The comprehensive assessment revealed a discernible positive impact on participants, as evidenced by heightened engagement in language-teaching activities. Notably, there was conspicuous growth across all facets of communicative competency, with a particular emphasis on linguistic and sociocultural proficiency among pre-service English teachers.

The findings suggested that the integration of targeted professional development initiatives significantly contributed to the enhancement of participants' capabilities and preparedness for their future roles as English educators. The increased engagement observed underscores the practical relevance and applicability of the implemented strategies within language teacher preparation programmes. Additionally, the noticeable advancements in linguistic and sociocultural competencies pointed to the programme's effectiveness in fostering a well-rounded and culturally sensitive approach to language instruction. In conclusion, the research outcomes validated the theoretical frameworks

presented in the analysed sources, providing empirical support for the positive outcomes of professional development interventions in language teacher preparation programmes. The observed improvements in communicative competency, particularly in linguistic and sociocultural dimensions, underscored the programme's success in shaping proficient and culturally aware pre-service English teachers. The positive responses and increased intercultural competency among participants proved the potential benefits of integrating sustainability into the curriculum for aspiring EFL teachers. Thus, the study conducted with 150 pre-service teachers from three Ukrainian higher education institutions proved that the incorporation of interactive workshops, professionally oriented practices, and a gradual progression towards independence in teaching activities were particularly well-received by the students. The study also revealed the positive impact of cultural awareness development within each module of the teacher training programmes. Students expressed appreciation for the integration of sociocultural material and activities based on intercultural issues.

CONCLUSIONS

The research highlighted that more than half of the participants identified challenges faced by different age groups of schoolchildren in learning English and actively engaged in research to find effective techniques and strategies. This research showcases the students' commitment to sustainability and their contribution to the academic community. The implementation of blended and online learning, especially through initiatives like the online pedagogical tandem, provided opportunities for internal and external academic mobility and knowledge sharing among students. The positive feedback from students and university practice supervisors in this regard emphasised the value of sustainable pre-service teacher professional development.

The second part of the study focused on how sustainability in pre-service teacher professional development affected the intercultural competency development of EFL teachers. Interviews with students highlighted the success of their professional and sociocultural competency development, indicating the effectiveness of sustainable pre-service teacher preparation programmes in the noted universities. The findings align with the framework proposed by Pastori and others, emphasising the interrelated nature of knowledge, values, attitudes, skills, and actions in intercultural competencies. In conclusion, the study provides compelling evidence that integrating sustainability into pre-service teacher professional development positively influences the development of intercultural competency among aspiring pre-service teachers. The results suggest that a continuous focus on sustainability within teacher preparation programmes also enhances linguistic and sociocultural competencies and contributes to a more holistic and globally aware generation of English language educators. The further research should address the core issue of training educators who possess the ability to effectively traverse the intricacies of a globalised world while

demonstrating cultural competency and environmental mindfulness what require collaborative efforts to create specific strategies and evaluation methods, to ensure that sustainability is not only recognised but also properly incorporated into language teacher education. None.

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CONFLICT OF INTEREST

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Розвиток міжкультурної компетентності: роль сталості у професійному розвитку вчителів переддипломної освіти

Анотація. Розвиток міжкультурної компетентності та сталого розвитку в процесі підготовки вчителів є важливим для підготовки педагогів до вирішення проблем швидкозмінного світу та створення інклюзивного, соціально відповідального та екологічно свідомого освітнього середовища. Метою цього дослідження було вивчити роль сталого розвитку у професійному розвитку вчителів та його вплив на формування міжкультурної компетентності. У дослідженні було використано два ключові методи, які допомогли зробити сталий розвиток ядром освітньої стратегії: аналітичний метод та метод розвідувальних інтерв'ю як інструмент збору даних. Основними шляхами сталого професійного розвитку вчителів міжкультурної компетентності були безперервна педагогічна практика, внутрішня та зовнішня академічна мобільність, інформальна/неформальна освіта та співпраця зі стейкхолдерами. Вищезазначені заходи були ретельно розроблені, щоб забезпечити всебічний професійний досвід для викладачів, сприяючи їхньому зростанню в галузі викладання англійської мови та сприяючи культурному взаєморозумінню. Результати дослідження довели, що інтеграція цілеспрямованих ініціатив з професійного розвитку суттєво сприяла підвищенню спроможності учасників та їхньої готовності до майбутньої ролі вчителів англійської мови. Зростання активності учасників підкреслює практичну значущість і застосовність впроваджених стратегій у програмах підготовки вчителів англійської мови. Результати дослідження підтвердили теоретичні засади, що забезпечують емпіричну підтримку позитивних результатів втручань з професійного розвитку в програмах підготовки вчителів англійської мови. Покращення в лінгвістичному та соціокультурному вимірах підкреслюють успіх програми у формуванні кваліфікованих і культурно обізнаних майбутніх учителів англійської мови. Результати дослідження можуть бути використані закладами вищої освіти, які готують майбутніх учителів, а також організаціями, що впроваджують програми професійного розвитку вчителів, з метою розвитку міжкультурної компетентності та впровадження принципів сталого розвитку в освітній процес

Ключові слова: програма підготовки; педагогічна практика; внутрішня та зовнішня академічна мобільність; інформальна/неформальна освіта; співпраця зі стейкхолдерами

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The effectiveness of quality assessment systems in early childhood education for preschooler's personal development

Abstract. The study aimed to analyse the effectiveness of assessment systems and their impact on developing and enhancing skills in preschool-aged children. An effective assessment system promotes the development of a child's cognitive, social, and emotional skills. Various approaches to assessment, their effectiveness, and their influence on children's emotional and cognitive development were highlighted. Recommendations for improving assessment practices were explored to ensure a child's harmonious development. The research included data collection for preschool child assessment systems, which involved several stages: observation, questionnaires, interviews, and data processing. An important aspect is that diverse assessment systems are employed in preschool institutions, aiding in determining children's developmental levels and the effectiveness of the educational process itself. The article examined the main types of assessment, including diagnostic, formative, summative, and comprehensive assessment, along with their characteristics. The administrations approved all procedures of preschool institutions and the ethics committee of the respective research organisation. Particular attention was given to the roles of educators and parents in the assessment process, as well as how feedback can contribute to improving learning outcomes and enhancing motivation to learn. Based on the analysis of empirical data, the most effective assessment practices ensuring the harmonious development of preschool-aged children were identified. Information on formative assessment, considered the most effective approach, is presented. Formative assessment is recognised as the most effective due to its regularity, flexibility, and ability to provide timely feedback. The findings of this study can be utilised by educators to improve the assessment systems in relevant preschool education institution

Keywords: preschooler development; skills and abilities; assessment methods; learning outcomes; observation; testing

INTRODUCTION

The quality assessment system in preschool education institutions (PEIs) is a crucial element of the educational process, as it influences a child's social and emotional development, as well as the formation of foundational skills and abilities. A wide range of assessment approaches exist,

differing in both methodologies and criteria. This diversity poses a challenge in identifying the most effective practices that promote positive emotional states, motivation, and learning progress in young children. One of the primary issues is the lack of unified standards and approaches

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to assessment, hindering comparisons of results and the implementation of successful practices across preschool institutions. Additionally, there is a concern about the impact of assessment systems on child development. While adequate assessment can stimulate interest in learning and foster the development of essential skills, an excessive focus on assessment can lead to stress, lowered self-esteem, and a loss of interest in learning. Therefore, it is essential to investigate how various assessment methods, particularly formative assessment, influence different aspects of child development.

There exists a wide spectrum of perspectives and opinions regarding the effectiveness and consequences of assessment systems on young children. Early childhood education is a crucial phase in personal development, as foundational skills and social habits are formed during this period. Assessment systems, particularly in preschool institutions, have been the subject of much debate, given their potential to have both positive and negative impacts on child development (Mettler *et al.*, 2023). As argued by P. Kasparova & J. Greaves (2023), traditional assessment systems often rely on standardised tasks and tests that measure each child's academic achievements. Such systems have been criticised for potentially limiting children's creativity and failing to account for their individual differences. According to J. Kang *et al.* (2024) and B.M. Gustafsson & M. Sund Levander (2024), standardised assessment in early childhood settings can induce stress and anxiety in children, negatively affecting their psychological well-being and motivation to learn. Alternative assessment approaches, such as portfolios and observations, have gained significant traction in recent years. These methods allow for a more in-depth evaluation of a child's individual progress, taking into account their strengths and interests. The use of portfolios enables the tracking of a child's development across various domains through the collection of work that demonstrates their achievements and progress over time, as noted by O. Karpinska *et al.* (2024).

F. Renaud *et al.* (2022) and D. Hao & W. Guohua (2024) assert that assessment in preschool education institutions significantly influences a child's development, encompassing emotional, cognitive, and social aspects. Standardised assessment systems can induce anxiety and lower self-esteem in children, particularly when they fail to meet expectations. Children may feel insecure, negatively affecting their overall emotional well-being and motivation to learn. While assessment focused on academic achievement can stimulate the development of certain skills, such as numeracy, literacy, and writing, excessive emphasis on these aspects may lead to the neglect of other crucial skills like critical thinking and creativity. Research by H.Q. Song *et al.* (2022) and F. Arici (2023) has shown that assessment systems that do not account for social skills and emotional intelligence can also result in the undervaluing of the need for cooperation and interpersonal relationships. Children who receive negative assessments may feel alienated from others, hindering the formation of positive social connections.

Alternative assessment methods such as observations and portfolios can better facilitate a child's development by taking into account individual differences and interests. These methods, as argued by S. King-Dowling *et al.* (2023), enable educators to create more supportive and individualised learning environments, fostering overall child development. Observing children at play can provide valuable insights into their social and emotional skills, as well as their problem-solving abilities and creativity.

C. Gao *et al.* (2024) and J. Dockrell *et al.* (2024) found it crucial to tailor assessment to the individual needs and characteristics of each child, as this allows for a more accurate identification of their strengths and areas requiring support. They also emphasised the need for active involvement of educators and parents in the assessment process, as this fosters a better understanding of each child's development and ensures a consistent approach to teaching and upbringing. Properly organised assessment can positively influence a child, helping to identify and address problems promptly while maintaining interest in learning.

This study aimed to analyse the effectiveness of quality assessment systems in early childhood education for a preschooler's personal development. In line with this aim, the study's objectives were to:

- review literature on the theoretical and methodological aspects of the research problem, existing methods and approaches, criteria, and indicators for assessing the quality of PEIs;
- study the experience of PEIs in using various quality assessment systems and determine their effectiveness;
- conduct an experimental study of the attitudes of educators and parents toward formative assessment, its advantages, and its impact on preschoolers' personal development.

MATERIALS AND METHODS

A mixed-methods approach, combining both quantitative and qualitative methods, was employed to investigate assessment systems in early preschool educational institutions and their impact on child development. This approach allowed for a comprehensive understanding of the issue by integrating statistical analysis with the examination of participants' experiences.

The research was conducted in several preschool educational institutions within territorial communities, namely: PEI No. 712 (Kyiv), PEI No. 424 "Chaika" (Kyiv), and PEI "Yaponskyi sad" (Chaiky Village). The sample consisted of 60 children aged 5 and 6 (39% boys, 61% girls), 20 educators (5% male, 95% female) working in these institutions, 1 head of preschool institution No. 712, and 30 parents (50% male, 50% female) who participated in the study. The timeframe of the study was 3 months (March 2023 – May 2023). This selection of participants and the time frame was based on a random sample to ensure the representativeness of the data. The research was conducted in compliance with ethical norms of Declaration of Helsinki (2013) and including obtaining informed

consent from parents and educators, ensuring the anonymity of participants, and the confidentiality of the collected data. All procedures were approved by the PEI administration and the ethics committee of the relevant research institution. Data collection instruments:

1. Questionnaires – educators (an anonymous questionnaire consisting of 10 mixed-type questions focused on assessment methods, particularly formative assessment, their effectiveness, and challenges encountered) and parents A questionnaire containing 10 closed-ended questions with “yes”/“no” response options, covering the following topics:

- ➔ Are you satisfied with the quality of education provided by the preschool educational institution?
- ➔ Do you believe that formative assessment contributes to your child’s development?
- ➔ Do you receive regular feedback on your child’s progress?
- ➔ Do you participate in parent meetings and other institutional events?
- ➔ Do you believe that the preschool provides a supportive environment for your child’s development?
- ➔ Are you satisfied with the teaching methods used in the institution?
- ➔ Are you satisfied with your child’s social development in the institution?
- ➔ Are you satisfied with your child’s intellectual development in the institution?
- ➔ Are you satisfied with your child’s emotional development in the institution?
- ➔ Do you believe that preschool contributes to the development of positive moral qualities in your child?

2. Observations – over a three-month period, observations were conducted of the teaching and learning processes in the selected preschool institutions and their respective groups of 60 children. Child behaviour and reactions to formative assessment were recorded.

Observation content:

1. Recording of children’s behaviour.
2. Analysis of reactions to formative assessment.

Data collection was conducted in several stages:

1. The first stage involved obtaining permission from institutional administrators and parents, developing questionnaires, and creating observation plans.

2. The second stage involved conducting questionnaires, observations, and interviews. Documents were collected and analysed concurrently.

3. The third stage involved data processing and analysis: questionnaire data was subjected to statistical analysis, and observations and interviews were coded and analysed using thematic analysis, the results of which are presented in the study findings.

The quantitative analysis involved processing questionnaire data using descriptive statistics. Thematic analysis was used to identify the main themes and subthemes related to the impact of assessment on child development. Among the main limitations of the study, one can note the

limited geographic sample and the potential subjective influence of the researchers on observations. Nevertheless, the application of mixed methods of data collection allowed for the minimisation of these risks and ensured the reliability and validity of the obtained results.

RESULTS

Theoretical aspects of the impact of assessment on the development of preschool children

Assessment is a crucial component of the pedagogical process, as it helps educators understand the individual needs of each child and adapt learning programs accordingly to their developmental level. In early childhood, assessment is particularly significant as this period is critical for the formation of fundamental skills and competencies that influence subsequent learning and development (Kompilovic *et al.*, 2023). Specifically, there are several types of assessment. This research highlights formative assessment, which enables educators and teachers to understand at which stage of development each child is. Through this type of assessment, educators can identify a child’s strengths and weaknesses, allowing for the development of individualised approaches to teaching and learning.

Formative assessment, which focuses on the learning process rather than on the end results, is particularly effective in early childhood. It involves regular observations, conversations with children, and analysis of their behaviour and achievements in various activities. Through this, educators can make timely adjustments to the learning process, supporting the individual pace of development of each child. Formative assessment promotes the development of self-reflection in children, helping them to become aware of their achievements and areas that need improvement. Assessment plays a significant role in children’s cognitive development. It enables educators to evaluate children’s skill levels, identify their strengths and weaknesses, and make timely adjustments to the learning process, providing individualised support. Assessment systems can motivate children to learn and foster a sense of responsibility (Stepić *et al.*, 2023). Moreover, assessment helps educators determine which specific cognitive skills need to be developed, such as language skills, logical thinking, or problem-solving abilities. Additionally, assessment is a valuable tool for monitoring the effectiveness of educational programs and pedagogical methods, contributing to their ongoing improvement.

Modern technology opens up new possibilities for assessment in early childhood. The use of electronic platforms and software allows for real-time data collection on children’s development, enabling analysis and the creation of individualised learning plans. Furthermore, technology can provide interactive assessment methods, making the process more engaging and motivating for children. Assessment also has a significant impact on children’s emotional well-being, particularly in shaping their self-esteem. Positive feedback and support from educators contribute to the development of self-confidence, which is crucial for

further learning. Negative or non-constructive feedback can have the opposite effect, reducing motivation and interest in learning. Therefore, it is important that the assessment is balanced and takes into account the child's emotional state. While assessment in early childhood offers significant benefits, it also presents certain challenges. One such challenge is the subjectivity of observations, as they can be influenced by the educator's personal biases. Additionally, there is often a lack of time and resources for detailed assessments of each child. Another challenge lies in communicating assessment results to parents, who may not always interpret them accurately.

The theoretical underpinnings of assessment in early childhood highlight its importance for children's overall development. Assessment helps identify individual children's needs, fostering their cognitive, emotional, and social development, while also supporting the formation of positive self-esteem. Despite the challenges, assessment remains an indispensable tool for educators in preschool institutions. Assessing preschoolers' knowledge is a crucial aspect of the educational process as it allows educators to identify each child's unique needs, promote their holistic development, and detect potential issues early on. The primary criteria for assessing preschoolers' knowledge include (Chou *et al.*, 2023):

1. Language skills.
2. Mathematical skills.
3. Logical thinking.
4. Physical development.
5. Health and hygiene.
6. Emotional and social development.
7. Creative development.
8. Artistic activities.
9. Musical activities.
10. Dramatic activities.

According to the developmental aspects of preschoolers, assessment should be comprehensive and account for various facets of a child's development. Each of the aforementioned criteria helps educators gain a complete picture of a child's development, identify their strengths and weaknesses, and detect potential issues promptly, enabling the development of individualised learning plans. It is essential that the assessment process is ongoing and considers not only current achievements but also the dynamics of a child's development. This allows for the

creation of a supportive learning environment where every child can reach their full potential.

Assessment plays a crucial role in PEIs, contributing to the holistic development of children and ensuring the quality of education. The main reasons for its importance include the ability to determine children's developmental levels. This helps educators and parents understand where a child stands in terms of cognitive, physical, emotional, and social development. Based on assessment results, learning programs can be tailored to meet the individual needs and abilities of each child, promoting effective utilisation of each child's potential and avoiding the stress of tasks that are either too challenging or too easy. In cases of challenges, assessment can identify potential developmental delays or issues at an early stage. Therefore, there is a high likelihood of timely intervention and the provision of necessary support, which increases the chances of successfully overcoming certain difficulties. Assessment is also important due to the possibility of providing feedback, as it allows for aligning appropriate actions and ensuring a consistent approach to teaching and learning. Additionally, assessment contributes to planning and improving the educational process. This is because analysing assessment results enables early childhood institutions to make necessary adjustments to teaching methods and plans, enhancing the quality of the learning process and ensuring alignment with current requirements. Another key reason is motivation for children. The assessment conducted can encourage them to achieve new results and highlight the progress and success of preschool children. The final reason is to ensure quality education. Systematic assessment is an integral part of the system ensuring proper education. It allows for tracking the effectiveness of the preschool institution's work and monitoring compliance with standards.

Assessment of preschool children is distinguished by its focus on a formative approach, which provides continuous feedback and support, whereas traditional assessment often focuses on final outcomes. Formative assessment takes into account the individual characteristics and development of the child, promoting their harmonious growth. In preschool educational institutions, other assessment systems are also used to determine the developmental level of children and the effectiveness of the educational process itself. The main types of assessment include diagnostic, formative, summative, and comprehensive assessment (Table 1).

Table 1. Characteristics of each type of assessment in early childhood education institutions

Assessment type	Purpose	Methods	Timing	Outcome
Diagnostic	Determining the initial level of knowledge, skills, and abilities of a child at the beginning of the school year or before the start of a new curriculum	Observation, discussions with children, use of special diagnostic tests	At the start of the school year or before the new topic begins	Used for planning individual educational pathways and adapting curricula
Summative	Assessing a child's achievements over a certain period (end of the school year, completion of a specific stage of learning)	General observation, analysis of completed tasks, use of summative tests	At the end of the school year or after completing a specific topic	Used to determine overall progress, can be presented as a report to parents

Table 1. Continued

Assessment type	Purpose	Methods	Timing	Outcome
Formative	Supporting and guiding the learning process, monitoring a child's ongoing development	Daily observations, analysis of children's work, discussions, and play situations	Conducted regularly throughout the school year	Helps educators adjust teaching approaches and methods in a timely manner, provides feedback to parents
Comprehensive	A thorough study of a child's development in various areas: physical, social-emotional, cognitive, linguistic, etc.	Combination of different assessment methods, including observations, tests, play tasks, interviews with children and parents	Usually conducted several times a year	Helps create a holistic view of a child's development, identifying strengths and weaknesses, and determining future steps in learning and education

Source: compiled by the authors based on research X. Lv *et al.* (2022), S. King-Dowling *et al.* (2023), S. Heuser & A.Wolf (2024)

By analysing empirical data, the most effective assessment practices that ensure the harmonious development of children in early childhood education can be identified. These practices encompass interactive methods, individualised approaches, and engaging children in self-assessment, which fosters their motivation and interest in learning. A formative approach involves ongoing feedback between the educator and the child. Formative assessment allows children to receive immediate feedback, which helps them understand their achievements and areas for improvement. For example, using praise and encouragement for completed tasks helps children feel confident in their abilities and motivates them to continue learning. Each child is unique and has their own pace of development, interests, and abilities. An individualised approach entails adapting the teaching and learning process to meet the needs of each child. The educator observes the children, records their achievements and challenges, and based on this information, determines the optimal methods and pace of learning. This allows children to develop at their own pace without feeling pressured.

Interactive methods, such as games, creative projects, and group activities, encourage children to actively engage in the learning process. They foster the development of social skills, creativity, and critical thinking. For instance, during group games, children learn to cooperate, share, and resolve conflicts, positively influencing their social development. Involving children in self-assessment helps them develop awareness of their achievements and build reflection skills. Children learn to analyse their actions, evaluate their results, and identify areas for improvement. This fosters critical thinking and independence. For example, after completing a task, the educator might ask the child what they enjoyed, what was challenging, and how they can improve their results next time.

Visual tools, such as charts, graphs, and drawings, help children visualise their achievements and progress. This could include a success journal where the child, together with the educator, records their daily achievements. Visualising progress motivates children to reach new heights and gives them a sense of accomplishment. Effective assessment practices in early childhood education should focus on supporting the holistic development of the child, taking into account their individual characteristics and needs. Formative assessment, individualised approaches,

interactive methods, involving children in self-assessment, and using visual tools are key components that contribute to positive learning and development in preschoolers. These approaches help create a supportive learning environment where every child can reach their full potential and enjoy the learning process.

Additional assessment methods and tools include:

- observation – regular and systematic monitoring of children in natural play and learning settings;
- portfolios – a collection of the child's work (drawings, crafts, writings) that demonstrates their progress and achievements over a specific period;
- surveys and questionnaires – the use of relevant forms and surveys to gather necessary information from parents and educators about the child's development and acquired skills;
- play-based methods – the use of specially designed play tasks and problemsolving situations to assess specific skills and knowledge of children.

Assessment systems in PEIs aim to create a nurturing educational environment where each child can develop according to their unique abilities and needs. The choice of the most effective assessment system in preschools depends on specific circumstances, goals, and the individual characteristics of the child. However, among all types of assessment, formative assessment is often considered the most effective. There are several reasons for the effectiveness of this type of assessment:

- continuous monitoring of progress – formative assessment is carried out regularly, allowing for the constant tracking of a child's development and the timely identification of areas that require corrective action;
- individualisation of learning – by assessing the child consistently, educators can quickly adapt learning materials and approaches to suit the individual needs and development pace of each child;
- feedback – this assessment provides continuous communication between the child, educator, and parents, contributing to a better understanding of the child's achievements and challenges;
- engagement and motivation of children – assessment that takes place during the learning process can be a motivating factor for children, as they see their own progress and begin to realise what they still need to work on, what they are succeeding at, and where they may face challenges;

→ prevention of problems – formative assessment helps identify and address issues at an early stage, promoting more successful development for each individual.

Compared to other assessment types, diagnostic assessment is crucial at the beginning of learning to determine the initial level of knowledge and skills, but it does not provide ongoing monitoring. Summative assessment, on the other hand, gives an idea of a child's developmental achievements at the end of a specific period but does not allow for timely adjustments to the learning process. Comprehensive assessment is detailed and comprehensive but can be time-consuming and therefore not always practical for regular use.

II. Practical significance of formative assessment in preschool educational institutions and experience of its use

An anonymous survey of educators regarding formative assessment in preschool groups and the percentage of responses is presented below.

1. What assessment methods do you use to assess children's development in your group? (Fig. 1)

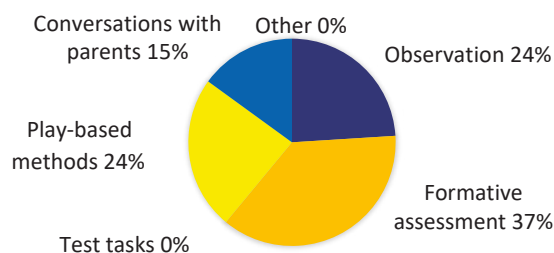


Figure 1. Results of respondents' answers to the first question

Source: compiled by the authors based on own research

Figure 1 shows the assessment methods used in the selected preschool groups in the study to determine children's development. It was determined that formative assessment, accounting for 37% and 24%, is primarily used to assess children's development. Specifically, observation, conversations with parents, and play-based methods are additional methods. The interplay of these methods helps to comprehensively assess both the cognitive and social skills of children, ensuring an individualised approach to each child.

2. Do you use formative assessment in your work? (Fig. 2)

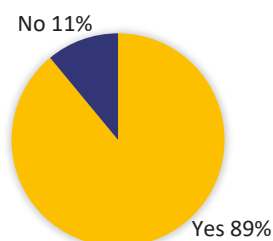


Figure 2. Results of respondents' answers to the second question

Source: compiled by the authors based on own research

According to the respondents' answers, particularly the educators (89%), formative assessment is a widely used system for assessing preschool children. Specifically, formative assessment helps to continuously monitor children's progress, providing feedback and adjusting teaching approaches. The use of formative assessment ensures an individualised approach and promotes the development of each child, supporting their interest in learning.

3. If yes, what specific formative assessment methods do you use? (Fig. 3)

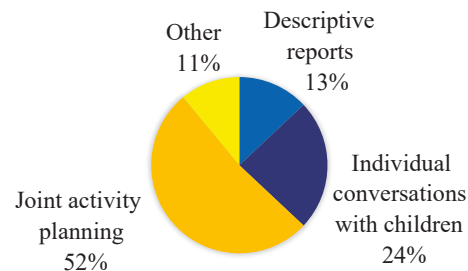


Figure 3. Results of respondents' answers to the third question

Source: compiled by the authors based on own research

This study has determined that respondents use several methods of formative assessment. Firstly, joint activity planning (52%) was conducted regularly, including various types of activities, recording their achievements and difficulties. Secondly, by using individual conversations, educators were able to discuss with the child their successes and identify areas that needed attention. Therefore, individual conversations account for 24% of responses. In addition, children were actively involved in self-assessment, being offered opportunities to reflect on their actions and results. Portfolio collections of achievements were also used, where children's works reflecting their progress were gathered.

4. How do you evaluate the effectiveness of formative assessment compared to traditional methods? (Fig. 4)

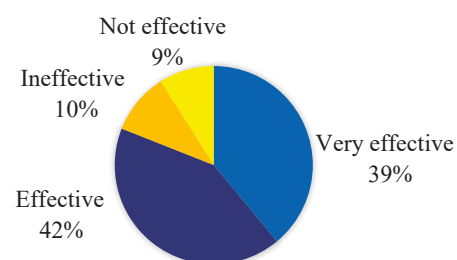


Figure 4. Results of respondents' answers to the fourth question

Source: compiled by the authors based on own research

Formative assessment is a highly effective tool compared to traditional assessment methods, as it creates a more dynamic and adaptive learning environment that promotes a deeper understanding of the material and the development of skills necessary for successful learning and

future life. Therefore, the majority of respondents indicated that formative assessment is very effective (59%).

5. What advantages do you see in using formative assessment? (Fig. 5)

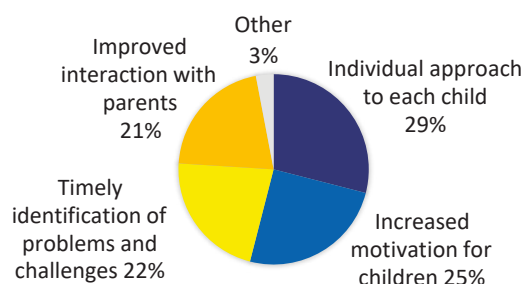


Figure 5. Results of respondents' answers to the fifth question

Source: compiled by the authors based on own research

The responses provided by the participants suggest that formative assessment offers many advantages, making it an effective tool in the educational process. These include improving the quality of learning, increasing motivation, an individualised approach, reducing stress, and providing feedback for teachers and parents.

6. What difficulties do you encounter when using formative assessment? (Fig. 6)

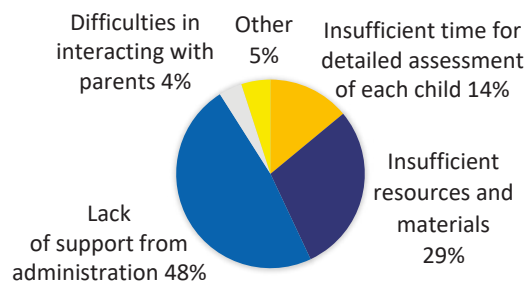


Figure 6. Results of respondents' answers to the sixth question

Source: compiled by the authors based on own research

To overcome the aforementioned challenges associated with formative assessment, the following measures can be taken. Firstly, to address the lack of resources, it is advisable to utilise freely available online resources, educational platforms, and materials. Secondly, to improve interaction with parents, regular meetings and workshops should be organised for parents, explaining the importance and benefits of formative assessment. It is essential to provide parents with clear and understandable information about the assessment process and the outcomes it can yield for their children. Thirdly, to avoid difficulties in assessing each child, it is advisable to use technology and specialised software to automate part of the assessment process. Fourthly, to obtain support from the administration, regular meetings should be held with the school administration, discussing the advantages of formative assessment and its impact on the quality of education. It is important to provide

specific examples of successes and achievements that have been attained through formative assessment. Additionally, it is possible to initiate the creation of working groups or committees that will support and implement this approach in the educational process.

7. How do you address these challenges? (Fig. 7)

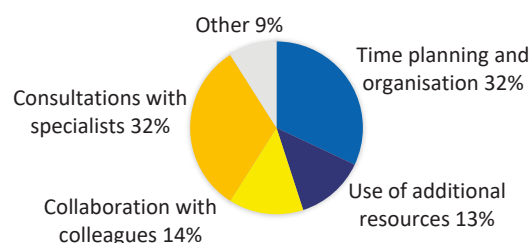


Figure 7. Results of respondents' answers to the seventh question

Source: compiled by the authors based on own research

If all methods are used in combination to overcome problems and difficulties, then it is possible to resolve them and thereby continuously improve formative assessment as a method for developing preschool children.

8. Do you require additional training or support regarding the use of formative assessment methods? (Fig. 8)

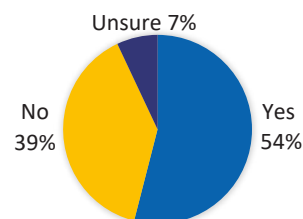


Figure 8. Results of respondents' answers to the eighth question

Source: compiled by the authors based on own research

While using formative assessment may not require additional training or support for educators, it is beneficial to attend specialised training and seminars to master formative assessment techniques. This includes learning how to develop assessment criteria, use technology to collect and analyse data, and provide effective feedback to students.

9. How often do you assess children in your group? (Fig. 9)

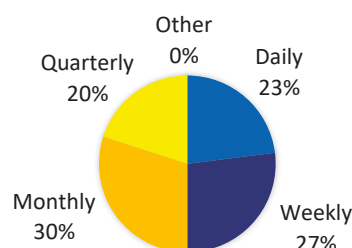


Figure 9. Results of respondents' answers to the ninth question

Source: compiled by the authors based on own research

Children in groups are assessed with the following frequency: weekly 27%, daily 23%, monthly 30%, and quarterly 20%. Importantly, any frequency is correct and necessary. There is no strict mechanism regarding the regularity of formative assessment. The final question, “What

are your recommendations for improving the assessment process in preschool institutions?”, was open-ended. By analysing the various recurring responses from educators, they were systematised into Table 2 according to the frequency of repetition.

Table 2. Results of educators’ responses on improving the assessment process

No.	Recommendation	Description
1	Individual approach	Taking into account the unique needs and abilities of each child for more accurate assessment
2	Observation of play	Assessing a child’s development through their play and interaction with others
3	Regular feedback with parents	Constantly informing parents about the child’s progress for joint decision-making on next steps
4	Creation of a positive emotional climate	Providing a comfortable environment for the child so they feel confident and can realise their potential
5	Use of technology	Utilising educational apps and programmes for a more interactive and engaging assessment process
6	Collaboration with other educators	Sharing experiences and methods among educators to improve the quality of assessment
7	Considering emotional and social development	Assessing not only academic knowledge but also emotional stability and social skills
8	Combining different assessment methods	A combination of observations, interviews, tests, and creative tasks for a comprehensive assessment

Source: compiled by the authors based on own research

Based on the data obtained, it was found that 89% of educators in the selected preschool educational institutions actively use formative assessment, indicating its high popularity and recognition among them. However, for its successful implementation, support from the administration, provision of necessary resources, and continuous professional

development of educators are required. An anonymous survey of parents of children also consisted of 10 questions regarding their perception of formative assessment, the level of satisfaction with their child’s development, and participation in the educational process. After analysing the obtained data, the results are presented in Table 3.

Table 3. Results of the parent survey in quantitative terms

Question	Responses	
	Yes	No
Are you satisfied with the quality of education provided by the preschool educational institution?	24	6
Do you believe that formative assessment contributes to your child’s development?	29	1
Do you receive regular feedback on your child’s progress?	13	17
Do you participate in parent meetings and other institutional events?	15	15
Do you believe that the preschool provides a supportive environment for your child’s development?	21	9
Are you satisfied with the teaching methods used in the institution?	26	4
Are you satisfied with your child’s social development in the institution?	27	3
Are you satisfied with your child’s intellectual development in the institution?	25	5
Are you satisfied with your child’s emotional development in the institution?	29	1
Do you believe that preschool contributes to the development of positive moral qualities in your child?	30	0

Source: compiled by the authors based on own research

Overall, parents highly appreciate the quality of education, teaching methods, and the level of development of their children in PEIs, and they have a particularly positive attitude towards formative assessment. However, some aspects, such as regular information about children’s

progress, require improvement. Observations of the teaching process and adherence to formative assessment in the selected preschools were assessed based on four criteria, with each criterion defined by three levels: high “+”, medium “+/-”, and low “-” (Table 4).

Table 4. Results of observations of children's learning and assessment in PEIs

	Individual approach to each child	Systematic and regular assessment	Active interaction with parents	Support for emotional and social development
Preschool educational institution No. 712	+	+	+/-	+
Preschool educational institution No. 424 "Chaika"	+/-	+	-	+
Childcare facility "Yaponskyi sad"	+	+	+/-	+

Source: compiled by the authors based on own research

All three PEIs demonstrate a high level of support for children's emotional and social development and carry out systematic and regular assessments. The most varied results were observed in the criteria of an individualised approach and active interaction with parents, where levels ranged from high to low. Observations of children were conducted to study their behaviour and reactions to formative assessment in various situations, including play, learning activities, and interactions with adults. Children demonstrated a high level of activity and creativity during play. The following behavioural patterns were observed: cooperation in group games, leadership qualities in individual children, and instances of conflict, which were usually resolved independently or with the help of adults. They exhibited varying levels of interest in learning activities. Most children were focused and active, but some required additional motivation and support. Children responded positively to feedback from adults. They quickly acquired new skills and adjusted their behaviour according to the recommendations received. An individualised approach allowed for a better understanding of the needs and characteristics of each child. Children who received individual consultations demonstrated a higher level of motivation and academic success.

To understand the approaches to assessing children in preschool institutions, an analysis of the preschools' internal documents was conducted, such as curricula, methodological recommendations for assessment, and children's development reports. It was found that preschool institution curricula are generally aimed at the child's all-round development. They include areas such as physical, cognitive, emotional, and social development. Curricula are often divided into different age groups, taking into account the specific needs and abilities of children. Methodological recommendations for assessing preschool children describe various methods and approaches to assessment, including observations, conversations, analysis of children's work, and testing tasks. Formative assessment, which focuses on the learning process rather than just the results, is emphasised. Children's development reports reflect the dynamics of each child's development throughout the academic year. They are compiled based on regular observations and assessments, as well as conversations with parents.

Based on the analysis of the activities of selected preschool education institutions, educators, parents, and children, prospective directions for developing an

effective assessment system for preschoolers have been identified: integration of technology in assessment (electronic platforms allow for the automation of data collection and analysis on children's development), individualisation of assessment approaches (individual learning plans, developed based on assessment results, allow for the adaptation of the learning process to the needs and abilities of children, promoting their harmonious development), personalised formative assessment (involves continuous monitoring of the child's achievements and difficulties, with adjustments made to teaching strategies according to their needs), collaboration with psychologists and specialists (ensures a comprehensive approach to assessing children's development), and educational programmes for parents (help explain the importance and methods of assessment and can foster better understanding and cooperation with educators).

DISCUSSION

The obtained percentage of responses indicating that systematic assessment is an integral part of ensuring proper education in this study confirms the opinions of researchers K. Krzysztofik (2024) and S. Nivins *et al.* (2024). It allows for monitoring the effectiveness of the preschool institution and ensuring compliance with standards. As revealed, assessment has a significant impact on the emotional level of children, particularly in shaping their self-esteem. Positive feedback and support from others develop self-confidence. Various assessment systems are used in preschool educational institutions to determine the level of children's development and the effectiveness of the educational process itself, however, formative assessment should be considered the most effective.

Research by scientists confirms the importance of assessment systems in preschool educational institutions and their impact on child development. In particular, the issue of early childhood assessment is uncertain and has both positive and negative aspects. On the one hand, research has shown that appropriately designed assessment systems can contribute to the early identification of children's abilities and developmental problems. This allows educators and parents to adjust the learning process in a timely manner and provide the necessary support to the child. These assessment systems must be flexible enough to take into account the individual characteristics of each child. After all, standardised approaches may not always

reflect the actual level of knowledge and skills of pupils. Moreover, the effective use of such systems requires highly qualified teachers who can correctly interpret the results and adapt the learning process to the needs of each child.

On the other hand, researchers V. Bedeković & M. Zeleničić (2022) and C. Cohrsen *et al.* (2024) warn about the potential negative impact on children due to an excessive focus on grades, which can lead to stress, decreased motivation, and self-esteem. The research confirms the above information and emphasises the importance of an individualised approach to each child, as standardised assessment methods do not always take into account the unique developmental characteristics and needs of each child, which can lead to incorrect conclusions and actions. This research, in comparison with the arguments of scientists, supports the idea of formative assessment, which involves ongoing monitoring and feedback. Such assessment helps to understand how a child learns and develops, and not just what they know or can do at a particular point in time. The assessment system should not displace play activities, which are the primary activity for preschoolers and an important means of their development. Play contributes to the development of creative thinking, social skills, and emotional resilience.

This research highlights the need to acknowledge the significant role of educators and parents concerning the assessment process. Their support and understanding are crucial for creating a supportive environment where a child can develop without fear of judgment. This study adds to the arguments about assessment systems in preschools, which should be well-considered and focused on supporting a child's all-round development. Assessment must be not only a means of measuring achievement but also a tool for improving the learning process and creating favourable conditions for children's development. Research by prominent scientists such as A. Chandio & M. Ali (2019), and K.F.B. Strooband *et al.* (2023) helps to understand how early assessment can contribute to identifying gifted children, as well as those who require additional support. This allows for the timely provision of necessary assistance and support for the development of each child. They determine that assessment can have a significant impact on the self-esteem, motivation, and emotional state of children. The research helps to understand how to create assessment systems that minimise stress and promote a positive emotional climate.

The study of the effectiveness of various assessment methods presented in this research and scientific research by A. Demangeon *et al.* (2023) enables educators to implement more sophisticated approaches in their work, contributing to better acquisition of knowledge and skills by children. In particular, such studies help to develop assessment systems that take into account the individual developmental characteristics of each child. This contributes to the creation of more personalised and effective learning programs. Notably, early experiences with assessment can influence attitudes towards learning throughout life. It is important to investigate how to create positive

assessment conditions that will foster a positive attitude towards learning and motivation for self-development.

The results found in this study contradict the views of J. Dockrell *et al.* (2024) regarding the significant impact of assessment systems on the development of social skills and cognitive abilities. An important aspect is understanding how these systems affect children's interactions within a group and their ability to cooperate and solve problems. The results of this study correlate with the views of M. Erfan *et al.* (2020) regarding the possibility of developing educational policies and standards that ensure fair and effective assessment of children in preschools. Moreover, the analysis of the effectiveness of assessment systems helps to improve the overall quality of early childhood education, ensuring better outcomes for children and society as a whole.

This research identifies the need to create favourable conditions for children's development and improve the quality of education in preschool institutions. The problem of assessment systems in preschool educational institutions and their impact on child development is more relevant than ever. In modern world, approaches to education are constantly changing, including assessment methods. Studying and improving these approaches helps to ensure more effective learning and development of children, following the latest scientific research and practices. In many countries, there is a growing focus on the importance of early childhood development. Assessment at the early stages of a child's life can have a significant impact on their future academic success and social adaptation. More and more preschool educational institutions are implementing inclusive programs where children with diverse developmental needs learn together. Assessment systems must be adapted to meet the needs of all children, making research on this topic extremely important. The research of N. Bikić *et al.* (2024) links the relevance of this topic to the constant striving to improve the quality of education. Effective assessment systems help educators better understand the needs and progress of children, contributing to a more personalised and effective approach to learning. Contemporary society faces rapid social changes that affect the structure and functions of the family, society, and educational institutions. Assessment systems must take these changes into account and help children adapt to new conditions. Assessment in PEIs is important for preparing children for further schooling. It helps to identify a child's strengths and weaknesses to ensure a continuous and successful educational process. Obviously, assessment results can be an important tool for parents, helping them better understand their child's development and support their learning at home.

Discussions regarding assessment systems in PEIs and their impact on preschoolers' development are critically important for building effective assessments to ensure the comprehensive and harmonious development of children in contemporary settings. Preschool children develop at different rates, and it is important to understand that

standardised assessments may not account for the individual characteristics of each child, leading to inaccurate conclusions about their abilities. This research has found that assessment helps determine a child's readiness for school. However, researchers L. Salaroli *et al.* (2024) and Gao *et al.* (2024) argue that school readiness should focus more on the development of social and emotional skills rather than academic achievement. Both educators and parents may feel pressure to achieve certain results. This can influence their approach to raising and educating children.

The aforementioned aspects form the basis for discussions on how to strike a balance between assessment and children's natural development, providing them with the best conditions for growth and learning. Contemporary researchers and their studies help to develop more effective and child-sensitive assessment systems that contribute to their harmonious development and preparation for further learning. This research refutes the opinions of other researchers and identifies priority directions for developing an assessment system for preschool children in modern conditions.

CONCLUSIONS

Assessment systems in preschool education institutions contribute to the allround development of children, fostering motivation, confidence, and an individualised approach to learning. Assessment in PEIs is a key tool that promotes children's holistic development, improves the educational process, and ensures highquality early childhood education. It has been found that formative assessment is considered the most effective due to its regularity, flexibility, and ability to provide timely feedback. Based on the analysis of data, conclusions have been drawn regarding the effectiveness of existing assessment methods and the main problems and difficulties have been identified.

Recommendations have been developed to improve the assessment process, which may include the introduction of new methods, the professional development of educators, the involvement of parents in the assessment process, and the use of modern technologies. Research on the topic of early childhood assessment through interviews and questionnaires has made it possible to develop practices, identify its strengths and weaknesses, and develop effective strategies for improving this important aspect of early childhood education.

Research into assessment systems for preschool children holds great potential for improving the quality of teaching and upbringing. The integration of modern technologies, comprehensive approaches, the professional development of educators, the active role of parents, and the introduction of alternative assessment methods are promising directions that can significantly improve the effectiveness of this process. Further research in these areas will contribute to the creation of a more comprehensive assessment system, promoting the harmonious development of children, preparing them for continued learning and life. However, like any other study, it has its limitations, namely, the age and individual characteristics of children. Preschool age covers a wide range of development, and assessment may vary for children of different ages within this group. Views on child development and learning can vary significantly. Prospects for further research include increasing the age range and the number of preschool children.

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CONFLICT OF INTEREST

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Ефективність систем оцінювання якості дошкільної освіти для особистісного зростання дошкільника

Анотація. Мета дослідження полягала у аналізі ефективності систем оцінювання та їх впливу на розвиток та удосконалення навичок дітей дошкільного віку. Ефективна система оцінювання сприяє розвитку когнітивних, соціальних та емоційних навичок дитини. Виокремлено різні підходи до оцінювання, їх ефективність та вплив на емоційний і когнітивний розвиток дітей. Розглянуто рекомендації щодо покращення оцінювання для забезпечення гармонійного розвитку дитини. У дослідженні проведено збір даних для системи оцінювання дітей дошкільного віку, який складався із декількох етапів: спостереження, анкетування, інтерв'ю, обробка даних. Важливим аспектом є те, що у закладах дошкільної освіти використовуються різноманітні системи оцінювання, які допомагають визначити рівень розвитку дітей та ефективність самого освітнього процесу. У статті проаналізовано основні види оцінювання, які включають діагностичне, формувальне, підсумкове, комплексне оцінювання та їх характеристику. Усі процедури були узгоджені з адміністрацією дошкільних закладів та етичним комітетом відповідної дослідницької установи. Окрема увага приділялась ролі педагогів та батьків у процесі оцінювання, а також тому, як зворотний зв'язок може сприяти покращенню навчальних результатів та підвищенню мотивації до навчання. На основі аналізу емпіричних даних визначено найефективніші практики оцінювання, що забезпечують гармонійний розвиток дитини в дошкільному віці. Подано інформацію про формувальне оцінювання, яке вважається найбільш ефективним. Виявлено, що саме формувальне оцінювання вважається найбільш ефективним через свою регулярність, гнучкість і здатність забезпечувати оперативний зворотний зв'язок. Отримані результати дослідження можуть бути використані вихователями з метою удосконалення системи оцінювання у відповідному закладі дошкільної освіти

Ключові слова: розвиток дошкільника; вміння та навички; методики оцінки; навчальні результати; спостереження; тестування

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Efficiency of dual education in training qualified specialists in the automotive industry

Abstract. The study aimed to determine the effectiveness of dual learning for training automotive industry professionals. Dual education combines theoretical training at an educational institution with practice at an enterprise in a ratio of 30-40% to 60-70%. This system is becoming an increasingly popular model of education. This is most relevant in industries that require highly skilled personnel. The automotive industry is one of the sectors where dual-system education is central in training specialists who meet the current needs of the labour market. The study covered such key aspects as the analysis of the theoretical foundations of dual education (studying the models and advantages of this training system); the assessment of the state of dual education in the automotive industry of Ukraine; and the impact of dual education on the training of specialists. The study determined that dual education can be an effective method of training qualified specialists, including in the automotive industry. Graduates of dual education have better practical skills, higher employment rates and higher salaries than graduates of traditional programmes. The study also identified several factors that contribute to the effectiveness of dual education. This includes cooperation between educational institutions and businesses. It ensures that dual education programmes meet the current needs and demands of the labour market and are flexible and adapted to changing workplace conditions. A well-organised mentoring practice at the enterprise provides graduates with the necessary skills and knowledge. Participants in dual education programmes were more motivated, motivated for their future profession and career, and can choose or change their specialisation during practical work at the workplace. The study results can be used in the formation of educational programmes, improvement of educational and methodological support of higher education institutions, and development of pedagogical models for training automotive industry specialists

Keywords: vocational education; vocational training; profession; practical training; employment

INTRODUCTION

The issue of effectiveness of education is one of the most important for both applicants and employers. Formal education is the basis on which further higher education, including non-formal and informal education, is built. According to the NUS (New Ukrainian School) standards, the key skill of a graduate is the ability to learn throughout life, which allows them to adapt to changes in society. Scientific and technological progress is developing rapidly, and some professions that were relevant 10 years ago are becoming unclaimed in the labour market. Therefore, modern-day graduates have to change in a fairly short time, take

additional training or even change their profession. In addition to the reasons mentioned above, global events such as the COVID-19 epidemic and the large-scale invasion of Ukraine by the Russian Federation in February 2022 have also made many adjustments. As a result, representatives of many professions have started working remotely, and combining several professions has become popular. As a result, theoretical knowledge has become even more important in practical application.

Dual education was first introduced in Germany in the last century (Gonchar, 2021). Every year, about half of the

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graduates of basic education in Germany receive education in the dual system. Most of them are employed at the companies where they studied. The prerequisite for the emergence of dual education was the need for vocational training to meet the requirements of the constantly changing labour market. In Ukraine, a pilot project on dual education lasted from 2015 to 2017 in vocational education institutions. The press service of the Ministry of Education and Science of Ukraine (MESU) reports that as of 1 January 2023, 27% of vocational and technical education institutions in Ukraine operate in dual mode, and 5% of students are trained in 117 professions (Trojan, 2023). Over a thousand enterprises were involved in this system during the three years of piloting.

The Scientific and Methodological Centre for Higher and Professional Higher Education has developed the "Concept for the Development of Dual Education" (Regulatory and legal support..., 2023), methodological recommendations and tools for the implementation of dual education. However, according to researchers of dual education in Germany, for more effective implementation of the dual education system and cooperation with employers, it is necessary to develop an updated legislative framework, educational programmes and modern professional standards, modernise vocational education institutions, change the approach to the training of higher education teachers and the approach to education in general (Rindfleisch & Maennig-Fortmann, 2020). This will allow for the transition from traditional to non-formal and informal learning, as they make it possible to best utilise the creative potential and abilities of students, and to acquire key professional and social competencies. Among the foreign researchers on the relevance of dual learning are R. Ermawati (2019), H. Ertl (2020), and K. Hähn *et al.* (2019), who considered the introduction of practical education in basic, secondary and vocational education institutions, as well as various aspects of dual education in the training of automotive specialists.

As such, R. Ermawati (2019) investigated vocational training in the context of the Industrial Revolution and new professional skills in the automotive industry, in particular, the effectiveness of teaching and the features of practice-oriented learning. It is emphasised that practical experience in the workplace is essential for successful employment and further career development. Mastering new technologies in practice affects the quality of education and the final product of industry. Therefore, the traditional model of education, where most of the material is theoretical, is less effective than the dual form. K. Hähn *et al.* (2019) explored dual education as a process of transition from study to employment and outlined 20 cases from various industries, including the automotive sector. The study noted that the successful implementation of dual education has improved the employment rates of graduates. In addition, industrial production reduces the cost of human resources. The successful interaction of all parties involved in dual education affects the development of the economy of the region and the country.

H. Lund & A. Karlsen (2020) analysed the relationship between vocational education and training institutions and industry, in particular the role of skilled workers in the introduction of technical innovations and, on the other hand, the improvement and adaptation of educational programmes to the needs of modern production. It is emphasised that the mismatch of educational material with the needs of industry has a negative impact on the quality of specialists. On the other hand, the innovations that students work within the workplace are gradually being introduced into the educational process. As such, the imbalance between the demands of the labour market and the supply of the education market is levelled.

The experience of European and Eastern countries (Germany, Czech Republic, India, Turkey, China) is quite successful: most graduates who have studied in dual education were employed, positively impacting the social and market economy of the country, shaping the competitiveness of both the individual industry and the economy as a whole. Therefore, the study of dual education implementation is closely related to economic issues: free competition in a particular profession significantly increases the productivity of learning and the welfare of society.

Therefore, the study aimed to address aspects of the effectiveness of the dual education system for training specialists in the automotive industry. Following this goal, the following tasks were set: to analyse the models of dual education in other countries (Germany, Austria, Switzerland), to determine the current state of dual education in the automotive industry in Ukraine, to study the impact of dual education on the employment of students, their professional qualities and employment rate.

MATERIALS AND METHODS

The study included an analysis of vocational and higher education institutions that train automotive professionals. A comparative analysis of the education systems operating in higher education institutions and vocational education institutions of Ukraine was conducted. Higher education institutions that provide dual-form education were analysed: Kryvyi Rih National University, National University of Zaporizhzhia Polytechnic, National University of Water and Environmental Engineering, Volodymyr Dahl East Ukrainian National University, Ukrainian State University of Science and Technology, Kharkiv National Automobile and Highway University. In particular, the study used analytical data according to the Analytical Report on the Implementation of the Pilot Project in Professional Higher and Higher Education Institutions for the Training of Specialists in the Dual Form of Education.

The study included an analysis of regulatory and legal documents, Regulatory and legal support for the implementation of dual education (2023), which ensure the implementation and functioning of the dual education system. The study analysed the Concept of training specialists in dual education, the peculiarities of its implementation, functioning and impact on several important sectors,

including educational, economic, professional and industrial; analysed the Methodological Recommendations and the Toolkit for the implementation of dual education. The author analysed the impact of the dual form of education on the modernisation of the content of education following the modern content of professional and occupational activities, establishing partnerships and cooperation between higher education institutions (HEIs) and employers, improving the quality of training of qualified personnel, increasing motivation, etc.

The study examined the criteria and factors that influence the successful cooperation between higher education institutions and automotive enterprises: the distance between the educational institution and production, the availability of appropriate curricula and educational methods, material and technical resources, the availability and number of specialities in which dual education is provided, the percentage of enterprises involved and the results of their interaction with educational institutions, the specifics of the educational process, etc. The advantages and disadvantages of the dual form of education in comparison with the regular form are studied. The factors and reasons that affect the effectiveness of the implementation and functioning of the dual form of education (for educational institutions, employers and

students), as well as the dynamics of dual education in Ukraine over the 4 years of the pilot project on the introduction of dual education are analysed. The experience of implementing dual education in Ukraine and in such countries as Germany, Austria, Switzerland, China, and India was analysed. The study addressed the peculiarities of implementing dual education in these countries, in particular, the methodology for developing educational programmes and disciplines, the practice of concluding trilateral agreements between participants in dual education and its results, and the specifics of training automotive industry specialists.

RESULTS

The development of key competencies of students is envisaged and justified in the NUS (New Ukrainian School), but this system has been implemented in Ukrainian education for only 7 years. That is, higher education does not introduce these competencies in a cross-cutting way but based on the specification and speciality. Citing data from the MESU press service, I. Shevchenko (2019) noted that 175 higher education institutions use the dual education system (as of 01.01.2023), of which only one-third train automotive specialists. The number of students studying under this system is only 5% of the total number (Fig. 1).

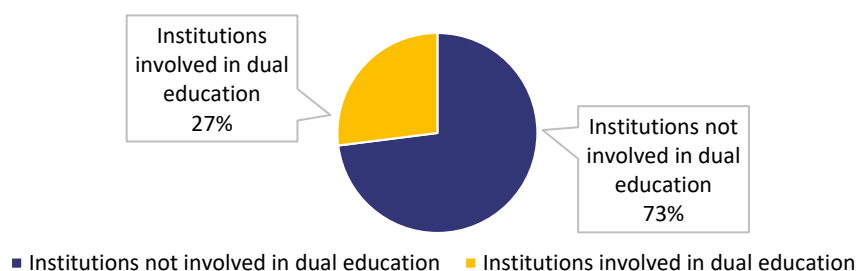


Figure 1. Institutions involved in dual education

Source: compiled by the author based on Analytical report (2023)

Thus, it is possible to state that despite the dual form of education existing in Ukraine, this area is still underdeveloped in practice for several reasons. In particular, only a part of higher education institutions provides educational services in the field of Industrial Engineering, and even fewer of them – do in the field of Automation and Instrumentation. The Faculty of Mechanical Engineering and Transport at Kryvyi Rih National University is a case in point. It trains specialists in the following specialities: 131 Applied Mechanics, 133 Industrial Engineering, 274 Road Transport and 275 Transport Technologies. Graduates of this faculty are practising engineers who can work at enterprises, institutions and various holdings in Ukraine and Europe in the automotive industry. The automotive production facilities operating in Ukraine were considered: ZAZ (Zaporizhzhia Automobile Plant), PJSC Eurocar (Zakarpattia region), Bogdan Corporation (with facilities in Cherkasy, Lutsk, Kremenchuk and Chernihiv), KrASZ (Kremenchuk Automobile Assembly Plant), LAZ (Lviv Bus

Plant), BAZ (Boryspil Automobile Plant), KhAZ (Kharkiv Automobile Plant), TATRA-Yug LLC (Kamianske, Dnipro region). Kamianske, Dnipropetrovsk region), Murovokurylovetskyi Machine-Building Plant (Vinnytsia oblast), Stryi Auto (Stryi Bus Plant, Lviv oblast) (Members of the Association of Automobile Manufacturers..., 2022).

Calculating the distance between Kryvyi Rih National University and the nearest production facility shows that the distance to Kamianske (TATRA-Yug) is 129 kilometres, and to Kremenchuk (KrASZ and Bogdan) is 200 kilometres. The other enterprises are located within 300-1000 kilometres. Therefore, cooperation of an educational institution under the dual education system is possible only with two or three production facilities, and even in this case, the distance between them significantly complicates the situation. Thus, the distance between the educational institution and the institution where the practical part of the training takes place is a significant obstacle to the successful implementation of dual-form education. In addition,

according to the results of the survey, there is a need to develop and improve the methodological framework, curricula, and trained teachers in higher education and vocational education institutions. According to the analytical report on the results of the implementation of dual education (which lasted from 2019 to 2022), in 2023, a total of 197 students received dual education. Of these, only 21 were in the automotive industry. At the Kryvyi Rih National University, mentioned above, only 3 students received dual-form education in the field of Industrial Engineering in 2022-2023 (Analytical report..., 2023). Notably, during the duration of the project, the number of dual-form education students increased from 441 to 553 in 2023. For objective reasons, their number was reduced in 2022, but the situation changed during the year.

The results of a survey of higher education institution representatives as part of the pilot project showed that some educational institutions still do not see the difference between full-time internships and dual enrolment, even though an information campaign has been conducted throughout the project (Analytical report..., 2023). All institutions that participated in the survey on the benefits of dual-mode noted that it is an effective and efficient system compared to the traditional form of education. There is an increasing need for qualified specialists in the automotive industry (in particular, due to the consequences of military operations in Ukraine), but partnerships with higher education institutions are still not regulated. Due to these and other objective reasons, the introduction of the dual form of education has several difficulties. It is the organisation of the educational process, as it must be aligned with both the individual study plan and the requirements and conditions of the employer, i.e. an individual educational trajectory must be developed. This requires additional negotiations (in the absence of a signed agreement) with employers. The survey of higher education institutions (as part of the project) showed that they lack developed methodological recommendations from the Ministry of Education and Science of Ukraine, of which at the time of the survey (2023) there were only recommendations for specialists in agricultural educational institutions.

One of the reasons that hinder the use of the dual form of education is low student motivation. The number of dual enrolments for bachelor's degrees was 197 and for master's degrees – 356 (as of 2022-2023). This situation is caused by an insufficient information campaign that would allow to widely highlight the benefits of the dual education system for students while presenting the industries interested in as many specialists as possible. However, difficulties also arise on the part of employers, who sometimes view students as full-fledged employees, forgetting the need for them to acquire theoretical knowledge (according to the dual education formula, 30% theory to 70% practice). In addition, some enterprises wanted guarantees that the student would remain employed at the enterprise after graduation, although they cannot demand such obligations

under the law (Analytical report..., 2023).

Among the problems are those caused by the full-scale invasion of Ukraine by Russia. Several companies were occupied or have ceased to exist altogether. On the other hand, there is a great need for qualified specialists who could provide high-quality automotive services, restoring vehicles for the needs of the Armed Forces of Ukraine. Due to the hostilities, some teachers and students changed their place of residence – they became internally or externally displaced persons, and some enterprises were relocated to other regions, which also had a negative impact on the implementation of dual education. There is also no updated full list of enterprises that are ready to work in the dual education format. For the same reason (martial law), distance learning was introduced in most educational institutions, and therefore the dual education process was absent, as most specialities cannot perform work tasks remotely (except for IT specialities).

According to the results of the analytical report of the pilot project for the implementation of dual education (Analytical report..., 2023), the employer response is as follows: out of 178 industrial facilities that cooperated with educational institutions, 128 trained only one student, and only 5% of enterprises trained more than 10 students. The percentage of automotive professionals trained in dual education is low. Employers also noted that dual education is the most successful and effective form of training and are ready to continue to cooperate with educational institutions in this area. At the same time, they noted that they prioritise quality over quantity (hiring fewer students but with more efficiency), as this greatly increases the competitiveness of the institution and meets the real needs of the labour market. Among the top 10 companies implementing dual education is a machine-building company (Krasnyansky JV Agromash LLC). However, regarding cooperation with the Kryvyi Rih National University, which trains automotive specialists and was taken as an example, it is not possible as the distance between them is more than 500 kilometres.

As a result of the analysis of the Concept of training specialists in the dual form of education and methodological recommendations for its implementation, conducted as part of this study, it can be stated that a significant number of enterprises are interested in cooperation with higher and vocational education institutions in the dual form (Regulatory and legal support..., 2023). First, this solves their main problem – the shortage of qualified personnel. This is due to both the popularisation of the dual education system and the understanding of its prospects for all parties (student – educational institution – employer). During the implementation of the pilot project, the participating companies were convinced that the dual form of education is the most profitable and effective: it meets all the basic requirements of the labour market and the company itself, allows for significant time and resource savings in training truly highly qualified specialists without spending money and time on their retraining and allows the student

to adapt to the production process much faster (as well as, to the team, which contributes to the development and improvement of communication between employees, the ability to work in a team, jointly solve complex problems, be proactive and responsible), to innovative technologies that are being introduced faster than the educational programme of the educational institution. Addressing the

events of 2022 that influenced the course of the pilot project on the implementation of the dual education system, and according to the results of the analysis, the initiators of cooperation agreements on dual education were mostly educational institutions (54%), and equally (23% each) employers and students, respectively (Fig. 2).

According to the analytical report of the pilot project,

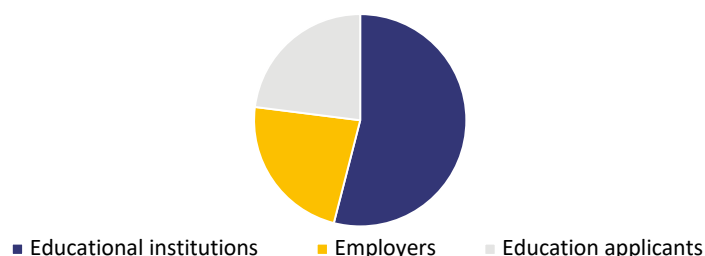


Figure 2. Initiators of the agreement on dual enrolment

Source: compiled by the author based on Analytical report (2023)

in the first years of the dual form of education, mainly technical and engineering, and agricultural enterprises were invited to cooperate. However, in the following years, medical institutions, pre-school and school education institutions, representatives of medium and small businesses, city councils and even military units employed the practice. This shows that the dual form of education is effective in all industries. To make it easier to use, the MESU has developed a Toolkit for implementing dual education, which provides step-by-step instructions for all participants (students – educational institutions – employers) (Tools for implementing..., 2023).

Students who were also interviewed as part of the pilot project noted that dual education is not only a source of additional knowledge, but also a motivation to build a successful career, and improve the quality of education (as the vast majority of respondents noted that offline learning is less productive than online learning), and an opportunity to receive financial rewards (including salaries from the company and certain types of bonuses and incentives). Among the reasons why students switched to dual education, the main one is financial, as well as gaining practical experience and the opportunity to have a job immediately after graduation. Competition in the labour market also contributed to the transition to dual education, as it allowed students to gain practical experience in the workplace and had many more advantages in employment than ordinary graduates. Among the shortcomings identified during their studies, students mentioned a significant gap between theory and practice, which they were able to overcome thanks to the dual form. In addition, with dual education, students were able to use their study time much more efficiently, as the distance learning mode, adopted by many institutions, allowed them to devote some of their time to practical training. When analysing their experience of dual education, students say that it allows them to work in their field of study, while other students have to change their profile

or retrain over time to meet the needs of the labour market. It is also noted that the outdated material and technical base of educational institutions do not contribute to better learning, as the equipment and facilities of enterprises have long been more modern and more accessible for innovation. Therefore, most respondents – students – believe that the dual form of education is much more effective, and promising and provides real practical experience. That is why 91% of students plan to stay working at the company where they received their practical education.

During the first years of the dual education system, only a small proportion of students (less than 50%) planned to work at an enterprise after graduation, but after 2022 the situation changed dramatically: two-thirds of students (74%) continued to work at the enterprise after graduation. Even though in some cases the company and the educational institution were in different cities, students planned to change their place of residence to continue cooperation with the company. This is also evidence that dual education is an effective means of addressing many issues in both education and the labour market. One of the biggest advantages of dual education is the opportunity to gain practical experience with further improvement. For example, electric and hybrid cars were developed in European countries, while Ukrainian manufacturers do not produce these types of cars. There are many owners of cars with electric motors in Ukraine, therefore the demand for their maintenance is also high. Practice at automotive companies provides an experience that would be impossible in an academic theoretical setting. Accordingly, students emphasise the need to digitise the educational process, which will significantly improve the legal side (trilateral agreements), as well as the production and educational ones.

The results of the analysis of the experience of introducing dual education in Ukraine and abroad (in countries such as Germany, Austria, and Switzerland) showed that the effective implementation of this system in the auto-

omotive industry reduced the shortage of personnel, led to the improvement of the dual education programme in the automotive industry, and influenced the employment of students. As a result, changes in the overall state of the national economy were recorded. Thus, China's experience shows that learning is highly effective when theoretical knowledge is combined with practical experience during the educational process. In this case, the outcome of the educational process (future specialists) correlates with the labour market and the needs of producers (employers). Since some German automotive companies have production sites in China, Chinese educational institutions have been implementing the experience of German vocational training to train highly qualified automotive specialists. Thus, the advantages and disadvantages of both training systems were identified and the most successful educational practices for the implementation of dual education were combined. Chinese strategy of higher technical education maximised practical experience while studying at an educational institution.

Improving competencies in the development of professional qualifications is part of the educational experience in India. When training automotive professionals, much attention is paid to the development and improvement of specific practical competencies. The peculiarities of the region (Southeast Asia) caused the need to improve the labour market, raise living standards, and create a successful career. Therefore, improving the quality of vocational education and key competencies of automotive professionals is a priority for higher and vocational education institutions. Ukrainian experience in implementing dual education is less than a decade old, while in other countries, it dates to a hundred years. For instance, in Germany, where the foundations of dual education were laid in the late nineteenth and early twentieth centuries. The success of the training, in which 30% is theory and 70% is practice, has led to the spread of this experience to other countries. J. Li (2019) compares the experience of China and Germany in implementing dual education, emphasising its high efficiency. The strong development of technology in both countries has led to changes in the education sector, and dual education can meet the needs of industry for qualified specialists who already have experience in production. In Ukraine, the functioning of dual education is not as widespread as in other countries, and this is due to the peculiarities of the economic, educational and legislative spheres. However, despite the rather short period of implementation of dual education, certain results are notable (Analytical report..., 2023).

Comparing the experience of implementing dual education in Ukraine and European countries, Y. Dovgenko *et al.* (2021) noted that Ukrainian higher education institutions are just starting to work in this direction, as previously practical training of students was only possible in vocational education institutions. University students acquired only theoretical knowledge, and after employment, they had to spend time acquiring skills at work, which in turn affected their competitiveness. In Austria and Swit-

zerland, the dual education system is successfully practised (Opushko, 2023; Kucher, 2023). Students not only acquire practical work skills but also complete course or diploma projects following employer requests. Such projects are paid for (and therefore the HEI has additional funds) and have an applied value, i.e., can be applied in practice. In Ukraine, dual education is implemented in several types: group and individual (e.g., Volodymyr Vynnychenko Central State Pedagogical University). Group education is part of the educational programme and is included in the curriculum. Individual education is formed following the applications of students themselves or requests from employers for a specific number of students.

Given that the education sector is of particular importance among others (as it has to provide specialists for all other sectors, given the rapid changes in society), the introduction of dual education is one of the most effective solutions for the successful development of the economy and society as a whole. Compared to other countries, Ukrainian higher education institutions are at the stage of developing mechanisms of interaction and cooperation between educational institutions, employers and students (Dovgenko *et al.*, 2021; Semenovska *et al.*, 2023). Due to several objective reasons, the number of students studying in dual forms decreased in Ukraine in 2022-2023 (Analytical report..., 2023). However, their number is gradually increasing. However, for the results of dual education to be truly high, this process needs to be continuous, as technologies are developing too fast, and the education sector must meet all the requirements of the labour market, considering innovative practices.

Currently, there is no ongoing consultation and support of students' projects by trade unions and enterprises in Ukraine, which negatively affects the organisation of training and the choice of future profession. According to the pilot project report, only a small proportion of students said that mentors (supervisors) from the enterprise sufficiently advised on the production and educational process. In other cases, there was no consultation schedule, and contact between the mentor and the student or the HEI took place only when necessary. However, in some HEIs (Taras Shevchenko National University of Kyiv, Kherson State Agrarian and Economic University), communication between representatives of the institution and the enterprise was continuous.

The introduction of the dual education system in the world was associated mainly with technical specialities, but its use is also appropriate in other industries. As for the automotive industry, it is a dual form of education that can provide it with highly qualified specialists. A survey of representatives of 164 companies as part of the pilot project showed a high interest of employers in cooperation with higher education institutions in the dual form of education, as it can effectively address the problem of staff shortages and ensure the quality implementation and development of innovations at the enterprise. The main advantage of the dual education system is that the company itself, in cooperation with the educational institution, can decide

what knowledge and skills will be acquired during the learning and practical application process. In this way, employers can choose specialists with a specific profile that meets the requirements of production: this reduces recruitment costs and reduces the risk of getting an unqualified employee.

According to the Regulation on dual education, this form of education can significantly reduce the shortage of personnel caused by the demographic situation, as it enables students to consider themselves a full member of society (receiving monetary rewards in the form of bonuses or salaries, contribution to the development of production, etc.) (Regulatory and legal support..., 2023). According to the results of a survey of dual education students, they are also interested in this form of education, as it provides an opportunity to study with further career development at the enterprise, receive money, highly qualified work, promotion, etc. During the two years of the pilot project (2021-2022 and 2022-2023), all dual-enrolled students (35 and 27 people, respectively) signed a trilateral agreement and continued their studies in cooperation with enterprises. In addition, all surveyed students signed an employment contract with an enterprise and held relevant positions (145 positions in 2023). 96% of respondents (261 students) said that the dual form of education is the most effective and promising (Analytical report..., 2023).

The largest number of students in dual education are in technical specialties (locksmiths, multi-disciplinary engineers, etc.). The transport system is particularly in need of specialists who already have practical skills in production. Therefore, the automotive industry has a high need to cooperate with higher education institutions to implement dual education, as the final product and labour productivity depends on both the level of theoretical training and the ability to apply it directly during the production process. The intensive development of technologies and innovations and their implementation in production in the automotive industry require specialists who can quickly adapt to production processes. The dual system is, in fact, a continuous education: from acquiring theoretical knowledge to applying it in practice throughout the entire training and after employment.

According to a survey of students in the pilot project, the most difficult part was combining simultaneous study in two places: HEI and on-the-job training. To some extent, this is due to the lack of a well-established mechanism of interaction between the educational institution and the enterprise. However, most respondents (96%) are satisfied with the results of their dual education, and all students plan not only to continue their studies in this form but also to cooperate with the company in the future with the prospect of career growth. Germany's experience in implementing dual education shows that this system has resulted in the lowest youth unemployment rate in Europe (2017) (Rindfleisch & Maennig-Fortmann, 2020). However, Ukraine is still in the process of transitioning to a dual system of education in vocational and higher education institutions, as it is difficult for HEIs to quickly reorient

themselves to meet the needs of employers.

Summing up all the above, the study established that all parties involved in the dual education system consider it an effective tool for solving several issues. With the development and digitalisation of production processes, the automotive industry needs even more specialists with practical experience in production. The constant changes and innovations in this industry mean that the curricula of higher and vocational education institutions must be adapted to these changes. However, with all the shortcomings and difficulties faced by the project participants, the dual form of education has significant advantages over other forms (internships, training, work placements, etc.). If several legal, regulatory, and methodological issues are resolved, this form of education can become a leading one in the field of education and can overcome the imbalance between the demands and needs of the labour market and available specialists. Thus, according to the Concept of training specialists in the dual form of education, the effective implementation of this system will help to solve several important educational, economic, professional and industrial issues. These include modernising the content of education following the modern content of professional and occupational activities, establishing partnerships and cooperation between HEIs and employers, improving the quality of training of qualified personnel, increasing motivation, etc.

DISCUSSION

The study demonstrated that dual education is a very effective model for training automotive specialists. Students studying in a dual programme acquire competencies that meet the real needs of employers. But the biggest advantage is that they gain work experience directly in production. This greatly enhances their competitiveness in the labour market and significantly increases their chances of finding a job. The results of this study correlate with the relevant results of studies conducted both in Ukraine and in foreign countries. H. Ertl & B. Hemkes (2019) analysed the German experience in implementing dual education, emphasising that it is the dual form of education that is most effective. Vocational education in Germany is an important factor in the transition from education to career. However, there is competition between educational institutions that provide only academic knowledge and vocational education and training institutions that operate in a dual form. However, the latter have a significant advantage, as they provide many more opportunities for further employment. Similarly, in Ukraine, most students and employers emphasise that dual education is the most effective among others.

T. Maier & S. Steeg (2019) investigated the competitiveness of dual degree students among others who received only academic knowledge. A survey conducted among employers determined that positive practical experience gained through dual education is much more effective in increasing the chances of getting a job. Since the automotive industry is one of the fastest growing (in particular, the transition to new fuels requires a fun-

damentally new engine structure and other mechanisms), education must be adapted and modernised to meet the needs and demands of the industry.

One of the objectives of the study was to determine the role of higher and vocational education institutions in training automotive industry specialists. This was also emphasised by H. Lund & A. Karlsen (2020) that skilled workers capable of implementing innovative technologies are of great importance in manufacturing industries. Their study substantiates the concept of interaction between industry and vocational education and training institutions. The analysis conducted by the researchers in two Norwegian production regions showed that the introduction of innovative educational programmes (dual form) in vocational education and training institutions, adapted to both modern and future production, significantly affects the competitiveness of manufacturers. The researchers emphasise the empirical component of the study, which demonstrates the theoretical concept of education modernisation, and emphasise the key role of qualified specialists in the effective implementation of the latest technologies in production. Ukrainian employers emphasise the important role of HEIs and vocational education in training specialists in the dual form, but the short time of dual education in Ukraine does not cause high employment results for students in this form.

In a monograph by S. Krone *et al.* (2019), the success of students who studied in dual mode compared to other entrants was empirically investigated. The researchers analysed several components, including subsequent employment, students' competitiveness in job search, impact on salaries, etc. The study covered one year and identified the reasons why dual education students have an advantage in career development compared to regular graduates. These include high-quality intensive training, flexibility of forms and methods of education, and support of such students by training companies interested in the formation and development of highly qualified specialists. The constant cooperation of employers, and their support of the educational institution at all stages of education, has contributed to the fact that both parties (the institution and the company) have benefited from the advantages. Such close interaction has a positive impact on the development of the region's economy and the country, which in turn affects the quality of life, social development, etc. According to scientists, the dual form of education itself contains transitional models and structures that help modernise the education system. In Ukraine, it is still difficult to talk about the development of the regional economy, which is influenced by the introduction of dual education, because the number of students studying in this form is quite small.

Similarly, the automotive industry in Ukraine is developing rapidly. Accordingly, there is a need for numerous specialists who can quickly navigate changes and ensure the process of creating and maintaining cars. However, only a small number of higher education institutions are ready to provide employers with highly qualified specialists with practical skills in the workplace for several reasons. The

study demonstrated that despite the existence of numerous theoretical works and research papers on dual education, there are still no developed curricula, methodological support, or forms and methods of interaction between educational institutions and manufacturing enterprises. This affects the quality of specialists who are employed after receiving higher or vocational education.

This study focused on cooperation between the education and production sectors. The results showed that in Ukraine there are almost no or only declarative programmes for the effective functioning of dual education. The same is stated in a study by M. Baitullah & W. Wagiran (2019), which analysed cooperation between higher education institutions and the labour market. The researcher highlighted the strategy of educational institutions in the field of vocational education, namely the procedures, forms and assessment of learning outcomes for further cooperation with industry. The study covered the administration of the educational institution, representatives of the employment service and heads of the HR department of the enterprise that cooperated with the educational institution. As a result of the interviews, the researchers concluded that the cooperation of the educational institution in this area began with a visit to the production site identification of needs, and analysis of the proposals that the institution could provide following the training profile and potential. In addition, the role of the teacher in the training of specialists was noted. In particular, the cooperation between the two parties took the form of training designed to improve the skills of students in technology and science; synchronisation and adaptation of curricula to meet the needs of industry; internships as an effective method of learning theoretical knowledge and the same time a means of feedback from industry representatives; tests and certification work; production fairs, etc. This study concluded that effective and timely cooperation between educational institutions (vocational and higher education) offering dual education and manufacturing enterprises has a significant impact on the development of the industry (in particular, the automotive industry) and the high competitiveness of both the students and the manufacturing facility.

The issue of introducing dual education applies not only to vocational schools but also to higher education institutions. For instance, N. Tastanbekova *et al.* (2021) addressed the aspects of using the dual form of education in higher education institutions. The study noted that this form of education raises students' awareness of the specifics of professional activity. The author addressed the specific competencies of the student at different levels: from educational programmes to the production process. The study analysed the competence aspect of implementing dual education, namely, from participation in scientific and practical conferences (where the academic component is implemented) to solving specific production tasks (where the practical component is revealed). According to the author, the use of dual education in higher education institutions also affects the psychological aspect of em-

ployment, as this model of education increases the level of motivation during study and employment, adaptation to the work process and mutual trust.

The results of this study coincide with the results of a study conducted by T. Viola (2020), which analysed innovative teaching methods (including dual education) in the automotive industry. The surveys showed a rather ambiguous attitude of students toward the dual form of education: some considered it too burdensome. However, employers, on the contrary, were interested in employees who already had practical experience when applying for a job. The study notes that the dual form can be combined with other innovative forms, such as cooperative learning and internships. An analysis of cooperation with employers in the automotive industry showed that they need qualified specialists capable of rapid adaptation, as this industry is one of the fastest growing and most innovative. Vocational and higher education institutions are usually limited to conducting laboratory classes that are detached from the realities of production. In other words, manufacturers want a well-established system of cooperation with educational institutions, because the efficiency and quality of production is directly proportional to the quality of employees' education. Therefore, according to the respondents (automotive employers), the main problem was the lack of awareness of students of production requirements. The low level of practical problem-solving in the workplace could not be compensated for by a high level of theoretical knowledge. To overcome this problem, the company had to spend a lot of time, which in turn affected the overall production rate and volume. Therefore, effective cooperation between educational institutions and enterprises should be aimed at overcoming these problems. This study also showed a mismatch between employers' needs for highly qualified specialists and the ability of higher education institutions to provide such specialists. This is due to the lack of a well-established procedure for students to gain practical experience within the dual form of education. In addition, there are other factors, such as the distance between the educational institution and the enterprise, non-adapted curricula, etc.

The study examined the benefits of a dual education system for training automotive professionals. The rapid development of technology and the automotive industry has led to a shortage of personnel with certain competencies. The possibilities of dual education have a high potential for their training, although the dual education system is only beginning to be implemented in Ukraine. This is also highlighted by N. Tkachenko & A. Hrytsenko (2023) emphasising that the main essence of the dual education system is the distribution of educational and practical tasks between the educational institution, enterprise and the state (labour market). According to the researcher, the benefits of dual education are provided to all participants: students, employers, and the state. However, as for the automotive industry, there are certain difficulties. Among them are objective reasons: unemployment, which is only growing in the context of a full-scale war, the prevalence

of theory over the practice in educational institutions due to the peculiarities of educational programmes, and most importantly, the imbalance between the demand for jobs and the availability of graduates of certain professions (in particular, over the past decade, the number of applicants for IT professions, economics and the law has increased, but technical and engineering specialities are still in demand in the labour market). According to N. Tkachenko & A. Hrytsenko (2023), transport companies are now in need of specialists with modern competencies due to the increased demand of society for transport services, which has changed significantly. This includes the digitalisation of infrastructure (mobile applications, management, etc.), automation of various processes (from production to management), as well as the transition to robotic production, the introduction of autopilot systems, etc. Therefore, the professional development of students studying in the dual form takes place with the constant support of managers who are directly aware of all production processes and can teach them how to act in specific situations and on real equipment, not in the laboratory of an educational institution.

The same aspects mentioned above are also emphasised by M. Pikula (2023) and O. Kravchenko *et al.* (2020). Scientists emphasise that the introduction of dual education is a very effective means of training future automotive professionals. However, they note that in the 2021-2022 academic year, only 7 students studied in the dual form of education at the National University of Water and Environmental Engineering (Rivne). As mentioned above, the percentage of HEIs that offer dual education is quite small. Meanwhile, the automotive industry is in the greatest need of such specialists, as not only the design of motor vehicles but also maintenance and technical equipment are constantly evolving and being updated. Computerised diagnostics and programmes for managing production and management processes are becoming increasingly developed.

H. Lund & A. Karlsen (2021) noted that vocational education and training institutions play an important role in regional economic systems. Qualified specialists influence the introduction and development of innovative technologies in production. The same conclusions can be drawn from the results of this study. K. Grupp & C. Hindley (2021) discussed the advantages of dual education (practical training) over traditional forms. In particular, the study emphasises the effectiveness of learning, in which the practical application of knowledge prevails over theoretical knowledge. The study was based on a survey and interviews with students who had completed their bachelor's degree. The survey results showed the high efficiency of dual and hybrid forms of education. A survey of students in Ukrainian higher education institutions had similar results.

The results of the study by N. Jalinus (2021) demonstrated that blended and integrated learning, which includes innovative approaches, increases the level of creativity, and flexibility of thinking and develops the key competencies necessary for a modern graduate to be successful in employment. This study has shown that em-

ployer surveys on the implementation of dual education in Ukraine also show that dual education graduates are more successful in their future careers. R. Kurniawan *et al.* (2021) and H. Maksum *et al.* (2024) noted that the professional quality of automotive specialists trained according to traditional models is not perfect. This results in a low level of employment of automotive workers. It is emphasised that it is practice-oriented training that can meet the requirements of employers for future graduates, including experience in the use of innovative technologies, practical skills in high-tech equipment, etc.

The peculiarities of the implementation of dual education were discussed by S. Suyitno (2022) and J. Witte & C. Felser (2019) in an analysis of experimental learning, during which students conduct research in practice: at automotive manufacturing enterprises, thus improving the theoretical knowledge gained in the educational institution. The practical application of knowledge was also discussed by B. Sudarsono (2020), emphasising the need for industrial practice in the training of automotive specialists. The study noted that this is how the necessary competencies and skills of a highly skilled worker are formed. J. Siswanto (2019) and M. Hernández-de-Menéndez *et al.* (2019) also addressed the topic, analysing the best practices of active learning and methods of implementing dual education experience. M. Nurtanto *et al.* (2020) and V. Poschauko & E. Kreuzer (2024) highlighted the need to improve the competencies of automotive professionals, including throughout their lives.

The digital and technological transformation of working conditions leads to the formation of specific competencies of students – future professionals – which are difficult to develop based on theoretical knowledge alone. Scientists emphasise the importance of dual and continuous education for workers in technical industries, including the automotive sector. The results of this study also indicate that dual education is the most effective form of education for automotive professionals. Thus, dual education is beneficial for improving the quality of education and further employment of graduates. However, its implementation requires support from the state, employers and educational institutions. The introduction and effective functioning of dual education can help Ukraine address the shortage of qualified specialists and increase the competitiveness of the Ukrainian economy in the global market.

CONCLUSIONS

Dual education, which is just beginning to be implemented and developed in Ukraine, is an effective means of training highly qualified automotive professionals. The ability to

apply the theoretical knowledge gained at an educational institution without interrupting studies is a significant advantage of this system compared to others. According to surveys of the pilot project participants, the effectiveness of the dual form of education is confirmed by all three parties: students, employers (business representatives), and higher and vocational education institutions. The growing demand for highly specialised professionals has led to qualitative changes in the education system, such as the introduction of dual education. The study determined that in Ukraine, only a fraction of enterprises cooperate with educational institutions to implement dual education, and the percentage of students enrolled in this form is also low. However, despite the difficulties faced by the participants in the pilot project, it can be concluded that dual education is a promising area in education. This is also evidenced by the growing trend in the number of participants (students and businesses) in dual education. However, there are still many aspects that need to be explored to make the results of dual education more effective. These include the development of teaching and learning materials, financial and legal support from the state, systematic analysis of the quality of education, work with government officials and trade unions, development of a systematic approach to the implementation of dual education, work in secondary education institutions (career guidance), creation of a database of vacancies and enterprises operating in dual form, etc.

The study had certain limitations: the inaccessibility of some data due to martial law, limited opportunities to communicate with students and representatives of enterprises, insufficient development of study programmes (including individual educational trajectories – according to the survey of HEIs), lack of a feedback procedure between all participating parties, etc. With comprehensive support from the state, the Ministry of Education and Science of Ukraine, and employers for the implementation of the dual education system, the above problems can be eliminated. Prospects for further research may include improving the educational and methodological support of higher education institutions, qualitative changes in educational programmes in line with innovative changes in society, development of a regulatory framework and recommendations for the implementation of dual education.

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CONFLICT OF INTEREST

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Ефективність дуальної освіти у підготовці кваліфікованих фахівців в автомобільній галузі

Анотація. Метою дослідження було визначення ефективності функціонування дуального навчання для підготовки фахівців автомобільної галузі. Дуальна освіта поєднує теоретичну підготовку в навчальному закладі з практичною роботою на підприємстві у співвідношенні 30-40 % до 60-70 %. Така система навчання стає все більш популярною моделлю освіти. Найбільше цього потребують галузі, де потрібні висококваліфіковані кадри. Автомобільна промисловість – один із секторів, де навчання за дуальною системою відіграє значну роль у підготовці фахівців, які відповідають сучасним потребам ринку праці. Проведене дослідження охопило такі ключові аспекти, як аналіз теоретичних засад дуальної освіти (вивчення моделей та переваг цієї системи навчання); оцінка стану дуальної освіти в автомобільній галузі України; вплив дуальної освіти на підготовку фахівців. Дослідження показало, що дуальна освіта може бути дієвим методом підготовки кваліфікованих фахівців, у тому числі й для автомобільної промисловості. Випускники, що навчалися за системою дуальної освіти, володіють кращими практичними навичками, мають вищий рівень зайнятості та заробітну плату порівняно з випускниками традиційних програм. Дослідження також визначило ряд факторів, що сприяють ефективності впровадження дуальної освіти. Зокрема це співпраця між навчальними закладами та підприємствами. Вона гарантує, що програми дуальної освіти відповідають актуальним потребам і запитам ринку праці, є гнучкими й адаптованими під зміни виробничих умов. Якісно організована наставницька практика на підприємстві забезпечує випускників необхідними навичками та знаннями. Як правило, учасники програм дуальної освіти більш мотивовані, мають чітке уявлення про свою майбутню професію та кар'єру, вони можуть обрати або змінити спеціалізацію протягом практичної роботи на виробництві. Результати дослідження можуть бути використані при формуванні освітніх програм, удосконаленні навчально-методичного забезпечення закладів вищої освіти, розробці педагогічних моделей підготовки фахівців автомобільної галузі

Ключові слова: професійне навчання; професійна підготовка; фах; практичне навчання; працевлаштування

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Analysis of international experience in implementing Artificial Intelligence in the educational process

Abstract. The relevance of this research lies in the rapid development of AI, which offers new opportunities for personalised learning, automated assessment, and improved teaching efficiency. However, it also presents challenges related to ethics, data privacy, algorithmic bias, and the potential decline in students' critical thinking. This study aimed to analyse current trends in the application of Artificial Intelligence in education. The study employed methods of scientific literature analysis, comparative analysis of international experiences from the USA, Japan, China, and the EU, and generalisation of the obtained results. Research has shown that the development of intelligent tutoring systems in the 1970s initiated the concept of personalised learning, but the complexity of modeling abstract concepts limited their effectiveness. Dynamic geometry environments significantly expanded visualisation capabilities for geometric processes, while integration with automated theorem-proving systems in platforms like GeoGebra and QED-Tutrix enabled formal proof verification. Additionally, mobile applications such as Photomath and Socratic simplify problem-solving, raising debates about their impact on the development of analytical thinking. International experience demonstrated different approaches to AI integration: in the USA and China, adaptive learning platforms (ALEKS, Knewton), virtual assistants (Cognii), and automated assessment systems (Gradescope) are widely used. In the EU, emphasis is placed on the ethical use of neural networks, while Japan has imposed restrictions on generative models in the educational process. In Ukraine, AI implementation is in its early stages; however, promising initiatives are being developed for its integration. The practical significance of this research lies in identifying promising directions for AI applications in education, which can be implemented in mathematical training programs at both higher and general education levels. The obtained results may contribute to preparing educators for the effective use of modern technologies and developing ethical standards for their application

Keywords: adaptive learning; personalised learning; automated assessment; intelligent tutoring systems (ITS); dynamic geometry software (DGS); geometric automated theorem proving (GATP)

INTRODUCTION

In the modern context of digital transformation in education, there is an increasing need to implement innovative technologies that enhance learning quality and foster the

development of key student competencies. One of the most promising directions is the integration of Artificial Intelligence (AI) into the educational process. The use of AI in

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teaching, particularly in mathematical disciplines, enables the creation of adaptive learning environments, automation of knowledge assessment, and support for a personalised learning approach. At the same time, the widespread adoption of AI in education brings several challenges, including the need to maintain academic integrity, develop critical thinking in the era of automation, and ensure the ethical use of technology.

Scientific literature devotes significant attention to the use of AI in education. Studies by V. Petrov *et al.* (2024) indicated that adaptive learning platforms contribute to improved student academic performance. The integration of AI into education, along with its advantages and risks, is further explored in the works of international researchers. The Mathematics Education in the Digital Era (MEDE) series examines how digital technologies support mathematics instruction and modern learning approaches, while also addressing educational debates (Richard *et al.*, 2022). H. Yoon *et al.* (2024) investigated the impact of generative AI on theorem proving, and C. Spreitzer *et al.* (2024) assessed the mathematical abilities of ChatGPT. M.L. Owoc *et al.* (2021) analysed AI implementation strategies in education. An IEEE panel discussion highlights the risk of standardisation and the need for AI oversight (Hurlburt & Reisman, 2024).

In China, intelligent platforms such as Yixue Squirrel AI are actively used in the educational sector, providing personalised learning and demonstrating high efficiency (Cui *et al.*, 2019). G. Hurlburt & S. Reisman (2024) explored Japan's experience in utilising AI to support language learning and programming skills development. Within the European Union, as noted by C. Spreitzer *et al.* (2024), ethical regulation of AI in educational institutions remains a critical aspect of technology integration. Despite its obvious advantages, AI in education also has certain drawbacks. For instance, H. Yoon *et al.* (2024) emphasised that the use of automated problem-solving systems in mathematics may reduce students' critical thinking abilities. The research aimed to synthesise international experience and provide recommendations for the effective integration of AI into the educational process.

MATERIALS AND METHODS

In the first stage of the study, an analysis of the current state of AI use in education was conducted. The research is based on recent studies (Owoc *et al.*, 2021; Spreitzer *et al.*, 2024; Tytarenko, 2024) that highlighted both the benefits and challenges of AI integration into learning. The key aspects of the problem were identified, including personalised education, automation of learning processes, and potential risks associated with AI use in education. The second stage involved the systematisation of scientific sources and an analysis of AI application approaches in education. Special attention was given to dynamic geometry systems (DGS) and automated theorem-proving reference systems (GATP), which are actively used in geometry instruction.

In the final stage, a quantitative and qualitative analysis of the obtained data was conducted. The study assessed the effectiveness of AI in the educational process, highlighting its advantages and drawbacks. Possible research limitations and future perspectives in this field were also considered. The research methodology included theoretical analysis methods (literature review, data synthesis, and systematisation); empirical methods (evaluation of platforms such as GeoGebra, ALEKS, and Knewton); comparative analysis (study of different approaches to AI implementation in education across various countries). The application of these research methods enabled an in-depth analysis of the practical aspects of AI use in education and access to real-world cases of its integration into learning activities. The technologies studied include adaptive learning systems, intelligent chatbots, personalised learning algorithms, and automated assessment systems. This approach allowed not only a deep understanding of theoretical aspects but also the identification of practical opportunities and challenges in AI integration into education.

Utilising diverse sources and platforms contributed to a comprehensive examination of the problem of developing digital literacy among future educators in the context of AI integration into the educational environment (Hurlburt & Reisman, 2024; Reuter, 2025). The analysis of the collected data identified effective AI application strategies in education, evaluated their impact on learning quality and provided recommendations for optimising the educational process using modern digital tools.

RESULTS AND DISCUSSION

Artificial Intelligence (AI) is becoming an integral part of modern education, transforming teaching, and learning approaches worldwide. S. Mallik & A. Gangopadhyay (2023) analysed studies published between 2003 and 2022, highlighting the evolution of AI applications in education over this period. They also emphasised how the COVID-19 pandemic accelerated the adoption of AI technologies in education. Despite significant progress, challenges remain, such as ethical concerns, algorithmic bias, and the need to ensure equal access to quality education. In various countries, AI technologies are used to personalise learning, automate knowledge assessment, adapt curricula, and support educators. In Ukraine, the implementation of AI in education is actively developing, yet certain trends and challenges can already be identified within the educational system (Financial Times, 2025).

A.R. Davydiuk *et al.* (2024) examine the impact of AI technologies on the teaching and learning of foreign languages in Ukraine. The authors emphasise that AI integration enhances the personalisation of the educational process, which is one of the key objectives of modern educational programs. AI facilitates interaction between participants in the educational process, serves as a mediator, and provides resources for educational needs. While the Ukrainian context aligns with broader European

educational trends, the authors note that further research is necessary to fully understand AI's role in education.

Ukrainian researchers confirm the significant potential of AI in improving education quality. M. Nazar (2024) highlights that AI reduces teachers' workload and promotes interactive teaching. B. Shevchuk (2025) investigates the integration of AI into virtual learning environments, focusing on the personalisation of computer science training for vocational education teachers. N. Tytarenko (2024) explores AI applications in mathematics instruction, while N.V. Kiyanovska *et al.* (2014) examine its role in higher technical education. V. Vasylenko & Yu. Tsyupachenko (2024) analyse international experience, emphasising challenges related to data privacy and digital inequality.

This study compares Ukraine's AI implementation experience in education with international practices, based on the findings of contemporary researchers. For instance, study by M.L. Owoc *et al.* (2021) demonstrates that AI technologies are more deeply integrated into the learning process in Western Europe and the United States, facilitating the personalisation and adaptation of curricula to students' needs. Similar conclusions were drawn by P.R. Richard *et al.* (2022), who highlighted the advanced adoption of AI-driven innovative teaching methods abroad. Additionally, studies by W. Cui *et al.* (2019) indicate the effectiveness of adaptive platforms, where student data analysis significantly enhances academic performance. Furthermore, research conducted by A. Zilberman (2024) and Vseosvita (2025) sheds light on issues such as algorithmic inaccuracies and AI "hallucinations" which partially align with observations made in Ukraine. Thus, comparative analysis suggests that while Ukraine's AI experience holds great potential for further development, it still requires methodological refinement and infrastructural support to reach the level of integration observed in leading countries worldwide.

The idea of personalised learning, which emerged in the 1970s with the development of intelligent tutoring systems (ITS), aimed to create autonomous platforms capable of adapting to students' needs. However, despite advancements in this field, the use of AI remained limited, particularly in geometry, due to the complexity of modeling human thinking and the abstract concepts of this discipline. One of the main challenges was providing adequate support for students in the process of formalising their mathematical reasoning and proofs. Alongside the

development of GATP in the 1980s, dynamic geometry software (DGS), such as Geometer's Sketchpad and Cabri Géomètre, emerged, allowing students to interact with geometric objects in real-time. This opened new opportunities for visualising geometric concepts; however, these systems did not provide formal proof capabilities. Therefore, although these technologies helped to make the learning process more interactive and accessible, they did not address the issue of a deep understanding of mathematical proofs.

Modern trends are focused on integrating GATP and DGS into a unified environment that combines both visualisation and automated proof methods. For example, GeoGebra successfully integrates geometric visualisation with algorithms for automatic proof generation, allowing students not only to explore the properties of geometric figures but also to understand proof processes. The QED-Tutrix project is developing an educational platform that helps students construct proofs while receiving feedback from the system. This enhances students' mathematical proof skills and fosters the development of critical thinking (Richard *et al.*, 2022; Nesterenko, 2023). In 2014, the mobile application Photomath was released, quickly gaining popularity among school students. It allows users to obtain equation solutions using a phone camera and was later enhanced to recognise handwritten text. Later, apps like Socratic and Microsoft Math Solver emerged, introducing new possibilities for automated mathematical problem-solving. These technologies, much like calculators in the past, sparked a new debate about their role in mathematics education. On the one hand, they greatly simplify solving standard problems; on the other hand, they may limit the development of independent problem-solving skills if not used alongside methods that foster analytical thinking (Godetska, 2024).

Thus, the integration of AI in mathematics education creates new learning opportunities but also requires rethinking the role of traditional teaching methods and their interaction with new technologies. In the future, it is crucial to find a balance between using automated tools and fostering deep cognitive processes that enable students not only to obtain results but also to understand the logic and structure of mathematical proofs. The use of Artificial Intelligence in the educational process varies across countries depending on the level of technological development, government policies, and access to digital resources (Table 1).

Table 1. Comparative analysis of the use of Artificial Intelligence technologies in the educational process of different countries

Country	Key Features of AI Implementation	Application Examples	Characteristics and Challenges
USA	Development of adaptive learning and automated assessment	ALEKS, Knewton, Alta – adaptive learning platforms; Gradescope – automated assessment system; Cognii – virtual learning assistant.	High level of personalised learning but concerns about data privacy remain.
China	Government support, use of big data for personalised learning	Yixue Squirrel AI – adaptive learning; DeepSeek – AI-based educational courses; Wudao 2.0 – virtual student.	Intensive digitisation of education, but ethical concerns regarding data use.

Table 1. Continued

Country	Key Features of AI Implementation	Application Examples	Characteristics and Challenges
EU	Combination of technological innovations with ethical standards and regulatory frameworks, development of private initiatives	AI educational modules for students and teacher training (France); Siegen University (Germany); AI Leap program (Estonia); Century platform (UK); government initiatives for safe technology use.	Strong focus on ethical aspects, need for alignment among countries, and teacher training for effective AI use.
Japan	Limited use of generative AI in academia, focus on research projects	Benesse – educational resources for creative skills development; flexible AI application in higher education.	Balancing technological progress with academic integrity.
Ukraine	The initial stage of AI integration, use for personalised learning	GIOS – analysis of students' mathematical knowledge.	Insufficient digital infrastructure, need for teacher training, and resource expansion.

Source: author's findings

In the USA, AI integration in education is characterised by the widespread use of adaptive platforms such as ALEKS, Knewton, and Alta, which analyse student responses and adjust learning materials accordingly. Additionally, automated assessment systems like Gradescope, as well as speech recognition technologies and virtual assistants from companies such as Nuance and startups like Cognii, contribute to improving teaching quality and personalising the learning process. In China, AI implementation is supported by the government and relies heavily on big data. Platforms like Yixue Squirrel AI provide adaptive learning by tailoring assignments to each student, significantly improving academic performance. Leading universities also offer courses focused on AI technologies such as DeepSeek, reflecting a systematic approach to integrating innovations into education. Moreover, projects like the development of a virtual student based on Wudao 2.0 demonstrate a high level of technological advancement.

In the EU, AI adoption in education is accompanied by both technological innovations and the development of ethical standards and regulations. In countries such as France, students gain AI literacy through specialised online courses and teacher training modules, ensuring the safe use of technology. These initiatives focus on personalising education and enhancing the quality of educational programs. The Japanese education system integrates AI through recommendations from the Ministry of Education, which limits the use of generative AI in academic work to maintain academic integrity. Schools utilise innovative resources developed by Benesse to support research projects and foster creativity among students. Higher education institutions adapt AI applications to specific disciplines, contributing to the development of flexible and efficient learning approaches.

Unlike developed countries, AI adoption in Ukrainian education is still in its early stages. The GIOS platform, which employs AI elements to analyse students' mathematical knowledge, demonstrates the potential for personalised learning. However, challenges such as insufficient digital infrastructure and the need for extensive teacher

training require additional efforts to enhance the integration of AI in education. The comparative analysis indicated that countries with advanced infrastructure and strong government support successfully integrate AI into education, ensuring a high level of personalisation and adaptability in educational programs. While Ukraine has promising initiatives, further efforts are required in methodology development, teacher training, and expanding access to digital technologies to achieve a similar level of AI integration in its education system (Iliyuchuk, 2024).

In the USA, where AI technologies are actively integrated into education, some of the most well-known examples include adaptive educational platforms such as ALEKS and Knewton, which personalise the learning process. These systems analyse students' responses and adjust learning materials according to their knowledge level, optimising the educational experience. Knewton has also developed the Alta platform, which combines adaptive technologies with high-quality open content, helping learners identify knowledge gaps and offering relevant educational materials. Automated assessment systems, such as Gradescope, successfully analyse both text and handwritten student responses. This helps teachers quickly evaluate work, significantly reducing their workload and allowing for more effective monitoring of the learning process. Other technologies, including speech recognition and data analysis systems, are actively used to monitor students' learning activities and assess their progress.

Another prominent example of AI integration in education is Nuance, a company based in Burlington, Massachusetts, which has developed speech recognition software. This technology not only assists students with mobility impairments or writing difficulties but also improves spelling and word recognition. For educators, it serves as a tool for automating certain teaching processes, such as preparing assignments or sending electronic communications. The startup Cognii stands out for using virtual assistants to support conversational pedagogy methods. These virtual assistants provide individualised tutoring, real-time feedback, and personalised student support. This significantly

enhances learning efficiency by creating an environment for active student engagement in the educational process. Another notable example is Querium, a startup from Austin, Texas, which offers personalised learning modules that help students develop critical STEM skills. Using AI, the system analyses students' learning habits and provides educators with detailed analytics, allowing them to adjust teaching strategies and focus on areas where students need to improve (Owoc *et al.*, 2021). China is a leader in utilising big data and Artificial Intelligence in education. The government actively funds the development of AI-powered educational platforms that assess learning efficiency in real time. These initiatives not only enhance education quality but also create innovative teaching methods that integrate cutting-edge technologies.

A significant step in AI integration in education is the introduction of AI courses in leading Chinese universities. In February 2025, Chinese universities, including Shenzhen University, Zhejiang University, Shanghai Jiao Tong University, and Renmin University, launched programs focused on DeepSeek technologies. These courses cover key technologies and address ethical norms, security, and privacy issues, fostering innovation in education and technology. Moreover, universities are implementing these technologies to improve their educational platforms. For instance, Shanghai Jiao Tong University uses DeepSeek to modernise learning systems, while Renmin University actively incorporates these technologies into its educational and administrative processes (Reuters, 2021).

China is also actively implementing AI in adaptive learning, significantly personalising the educational process. The Yixue Squirrel AI platform, launched in 2016, is an example of the successful application of machine learning for real-time student knowledge analysis. It adapts assignments based on each student's needs, greatly improving learning efficiency. W. Cui *et al.* (2019) investigated the effectiveness of the adaptive learning system "Yixue Squirrel AI" for middle school students in China. They compared students' learning outcomes in mathematics and English using this system with traditional classroom instruction conducted by expert teachers, as well as with another adaptive English learning platform called BOXFiSH. The results showed that students who used the "Yixue" system achieved better learning outcomes compared to both traditional instruction and the other adaptive platform.

One of the most impressive achievements in the use of AI in education has been the creation of the virtual student Hua Zhibing, developed based on the deep learning model Wudao 2.0. This virtual student, designed by the Beijing Academy of AI in partnership with Zhipu.AI and Xiaoice, is capable of processing up to 1.75 trillion parameters and can already write poetry, draw, and express emotions (Fan, 2021). This project is actively supported by China's national AI development strategy, which promotes the integration of AI technologies into various fields of life, including education. Chinese universities are also actively developing tools for the automated grading of written

assignments. For example, a university in Zhejiang Province has started using an essay grading system developed by Alibaba. This system can check grammatical errors in texts with accuracy surpassing that of humans, while the grading process takes only 40 seconds. However, it is not yet capable of evaluating the style and structure of sentences, which is one of the current limitations of the technology (iPress, 2018). Nonetheless, this system is a significant step toward automating assessment and enhancing learning efficiency.

China is also actively developing student attention monitoring systems using cameras and facial recognition algorithms. These systems assess students' engagement levels during lessons and help teachers better understand how students perceive the educational material. They can be used to adjust teaching methods and improve teacher-student interaction. In the European Union, AI technologies are actively being integrated into the educational process, particularly through national initiatives and programs aimed at preparing students and teachers for future technological challenges. France has become one of the leaders in integrating AI into educational programs. Starting in September 2025, students in grades 8 and 10 will study AI fundamentals, while online courses will be available for other educational levels. Teacher training is a key component of this initiative, with 10 training modules developed to cover various aspects of AI use in the classroom. Additionally, a document outlining ethical norms and standards for AI use in schools is planned to ensure the safe and responsible application of these technologies (Voloshyn, 2025).

As part of the effort to develop students' digital skills, France also plans to introduce an AI-based application, MIA, for 800,000 10th-grade students. This tool will assist students in learning French and mathematics by providing personalised exercises that adapt to each student's needs. AI algorithms will analyse student responses and recommend the next tasks, optimising the learning process and increasing its effectiveness (Ukrinform, 2023a). Germany's experience in implementing Artificial Intelligence in education is vividly demonstrated by the practice of Siegen University. This institution has established a special support structure aimed at integrating digital technologies, particularly generative AI, into teaching. The Digital Teaching Team at Siegen University actively collaborates with the administration, faculty, and students, adapting AI tools to real educational needs. The primary focus is on personalised learning, automated knowledge assessment, and developing students' critical thinking in working with AI. The key areas of work for the support structure, which was created and implemented at the university to develop students' skills during the learning process, include:

- Awareness – enhancing understanding of AI's potential in education.
- Professional growth – improving teaching methodologies through digital solutions.
- Infrastructure – creating a technological framework that meets the needs of both faculty and students.

- ➔ Experimentation – testing new AI tools in the educational process.
- ➔ Support – providing technical and didactic assistance for digital learning.
- ➔ Coaching – offering individual and group consultations on AI usage.
- ➔ Collaboration and exchange – building a community for interaction and experience-sharing on digital technologies.
- ➔ Monitoring and reflection – assessing the effectiveness of AI tools in education.
- ➔ Assessment – developing digital tools for evaluating student knowledge (Larina, 2024).

The initiative at Siegen University demonstrates that a comprehensive approach to AI integration in education can significantly enhance teaching effectiveness, making learning more personalised and adaptive. The implementation of AI technologies contributes not only to improved academic performance but also to developing students' digital literacy skills. Estonia is also actively implementing AI initiatives, particularly through the national program AI Leap. This program aims to equip high school students with AI skills in collaboration with leading technology companies such as OpenAI and Anthropic. The program covers around 20,000 students aged 16-17 and 3,000 teachers, providing access to AI learning tools and fostering critical thinking. The project has a budget of €3.2 million, with plans to expand it to €6 million. Additionally, there is a strong focus on ensuring digital equality, especially in underprivileged communities. By developing this initiative, Estonia aims not only to enhance young people's qualifications but also to promote innovation in education and combat misinformation (Ukrinform, 2023b).

Beyond government initiatives, private startups in Europe are also actively integrating AI into the educational process. One such startup is Century, founded in London in 2013 by Priya Lakhani. The Century platform utilises cognitive neuroscience and data analytics to create personalised learning plans, reducing the workload for teachers and providing students with individualised learning recommendations. This startup helps optimise the educational process by considering each student's unique characteristics, making learning more effective. A crucial aspect of AI development in the EU is its regulation. Starting February 2, 2025, specific provisions of the EU Artificial Intelligence Act will take effect, setting requirements for the safe use of AI in various fields, including education. The Act prohibits practices that violate ethical principles, such as manipulating people or infringing on privacy. Violating these requirements may result in substantial fines, emphasising the EU's serious approach to AI safety and ethics. For instance, within the EU, penalties could reach up to €35 million or 7% of a company's annual turnover within the EU (Deloitte, 2025).

In Japan, AI is being actively integrated into the education system, particularly through guidelines developed by the Ministry of Education for the limited use of generative

AI tools like ChatGPT. These guidelines allow AI to be used to generate discussion ideas and improve English communication skills but prohibit its use in completing creative assignments to prevent academic dishonesty. This approach reflects a commitment to academic integrity while allowing students to use AI to enhance language skills and develop critical thinking (Ukrinform, 2023a). Advancements in educational technology in Japan are not limited to the school system. The Japanese company Benesse has developed an AI-based resource to help elementary school students create their research projects. This service provides recommendations on topic selection, hypothesis formulation, and summarising conclusions, fostering independence, research skills, and critical thinking. Such an initiative enables children not only to acquire basic knowledge but also to develop skills that will be valuable in the future, ensuring a deeper approach to learning and self-expression (First Cambridge Center, 2023).

AI is also making its way into higher education in Japan. The Ministry of Education has encouraged universities to develop individual guidelines for using generative AI, tailoring them to specific programs and courses. This allows universities to integrate AI based on the needs and requirements of each discipline, ensuring a flexible approach to the learning process. As a result, the Japanese education system enables future professionals to work with cutting-edge technologies and apply them to solve specific professional challenges, enhancing graduates' competitiveness in the global job market (Ukrinform, 2023b).

In May 2024, the Ministry of Education and Science of Ukraine (2024), in collaboration with the Ministry of Digital Transformation, developed a draft set of recommendations for AI use in schools. This document provides clear guidelines on how to turn AI into an effective assistant for teachers, fostering innovation in the Ukrainian education system. The purpose of these recommendations is to promote principles and approaches for the responsible use of AI systems in general secondary education, ensuring human rights compliance, adherence to professional ethical standards, and increasing teachers' awareness of potential risks and challenges. This aims to enable educators to engage with AI systems critically, effectively, and ethically and fully utilise their potential. These recommendations are based on current international practices.

The integration of AI into Ukrainian education is still in its early stages, but the country is actively moving toward digitalising the learning process. The use of online learning platforms and AI technologies has already become a vital component of Ukraine's educational development. One example of such innovation is the Ukrainian platform GIOS, which incorporates AI elements to analyse students' progress in mathematics. This platform tracks student performance, automatically adjusts learning materials to their needs, and offers personalised assignments for better mastery of the subject. Such an approach makes learning more individualised and effective, providing teachers with valuable tools for precise student assessment.

Moreover, alongside these initiatives, Ukraine must develop other aspects of AI integration in education, particularly teacher training. Professional development programs should be created to equip educators with the necessary skills to effectively utilise AI to enhance student outcomes. This may require the implementation of training sessions and courses aimed at improving teachers' qualifications and helping them adapt to new educational realities. Although the introduction of AI into Ukrainian education is still in its early stages, its significant potential for improving the quality of the learning process is already evident. The successful development of such initiatives requires not only technological infrastructure but also a clear strategy and government support to ensure equal access to AI technologies for all students, regardless of their region or socioeconomic status. Successful integration of innovative technologies in education requires close collaboration between universities, the government, and industry, as well as the development of new methodological approaches to teaching that align with the modern labor market demands (Sichko *et al.*, 2025).

The use of Artificial Intelligence in the educational process has great potential to enhance learning quality. However, this process is associated not only with advantages but also with numerous risks and challenges that require careful examination and consideration. F. Kamalov *et al.* (2023) explore the impact of Artificial Intelligence on education, focusing on its applications, benefits, and challenges. In addition to the advantages, the authors also discuss potential negative aspects and ethical concerns related to the implementation of AI in education, emphasising the importance of responsible technology use.

One of the biggest issues related to AI in education is privacy concerns. As more and more student data is collected and stored on AI-driven online platforms, schools must take measures to protect the confidentiality of this information to prevent breaches or leaks. Surveillance is another concern, as facial recognition technology is becoming increasingly common in schools. If not properly controlled, its use could lead to unethical tracking of students' movements (Zilberman, 2024). The second most pressing issue in implementing modern AI is misinformation, which is currently referred to as "hallucinations" in Western European countries. AI can provide instant answers to questions but often does so superficially. When faced with complex or highly specialised queries, ChatGPT frequently struggles to find accurate and precise information, leading it to generate content by fabricating or mixing facts (Vseosvita, 2025).

Automated grading systems may be prone to errors or misconfigured algorithms, potentially resulting in unfair or inaccurate assessments. Additionally, there is a risk that teachers may overly rely on technology for evaluation, neglecting the importance of human judgment, including emotional and social assessments of students, which algorithms cannot always predict. Another challenge is the availability of modern infrastructure and internet access, which may be lacking in some regions or for socially

vulnerable groups. The war has further exacerbated this issue: due to the destruction of energy and telecommunications infrastructure, many communities are left without stable connectivity and electricity. The forced displacement of families, particularly to rural or frontline areas, complicates children's access to quality education. The lack of necessary equipment or network access may deepen the digital divide, preventing students from low-income families, internally displaced children, or those from war-affected regions from benefiting from AI-powered education.

The implementation of AI in education raises concerns about job security for teachers, as the automation of many processes, such as grading and selecting learning materials, may reduce the need for human involvement. While AI can be a powerful tool to support teachers, it is essential to ensure that technology complements their work rather than replaces them. Educators must remain at the center of the learning process, using their professional expertise to interpret and integrate AI-generated results effectively.

The intensive use of AI in education may have psychological effects on students, especially if they feel that their progress is assessed solely by machine algorithms rather than through the support of teachers or peers (Stanford University, 2023). A lack of social interactions and human communication could negatively impact students' emotional development, particularly at younger ages. Therefore, technology should be integrated in a way that fosters social interaction and emotional growth among students. Thus, the global experience of applying Artificial Intelligence in education demonstrates significant potential for transforming learning processes, ensuring personalisation, and improving education quality. However, each country faces unique challenges that require specialised approaches and implementation strategies. An analysis of international practices indicates that the successful integration of AI is only possible with systematic support, clear regulation, and the active involvement of all stakeholders. For Ukraine, this experience can serve as a guideline for developing effective solutions aimed at overcoming existing challenges, improving teaching methodologies, and maximising the potential of digitalisation in education.

CONCLUSIONS

This study analyses international experiences in implementing Artificial Intelligence in the educational process, revealing key trends, challenges, and prospects for applying this technology in various countries. It has been determined that AI is actively integrated into the educational systems of developed nations, including the United States, China, EU countries, and Japan, where adaptive learning platforms, automated assessment systems, and virtual assistants are widely used. The analysis has shown that the most effective approaches are comprehensive ones, which include not only the technical implementation of AI but also the development of pedagogical strategies and teacher training for working with new technologies. The use of AI contributes to personalised learning,

improved knowledge assessment, and the development of independent study skills. However, the study also highlights risks associated with excessive student dependence on AI, potential algorithmic biases, and concerns regarding data privacy and security.

Comparing experiences from different countries has made it possible to identify best practices that could be adapted to Ukraine's educational system. These include the development of national AI platforms, the creation of open educational resources based on AI, and the establishment of a regulatory framework for governing AI use in education. Future research in this field should explore the impact of AI on students' cognitive development, the

development of effective methods for integrating AI into the learning process, and the evaluation of these technologies' long-term effectiveness. Another important direction is improving interaction models between teachers, students, and AI systems to optimise and enhance the efficiency of the educational process.

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CONFLICT OF INTEREST

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Аналіз міжнародного досвіду впровадження штучного інтелекту в освітній процес

Анотація. Актуальність цього дослідження зумовлена стрімким розвитком штучного інтелекту, який відкриває нові можливості для персоналізованого навчання, автоматизованого оцінювання та підвищення ефективності викладання. Однак він також створює виклики, пов'язані з етикою, конфіденційністю даних, алгоритмічною упередженістю та потенційним зниженням критичного мислення студентів. Метою даного дослідження було проведення аналізу сучасних тенденцій застосування штучного інтелекту в освітньому процесі, оцінка його впливу на навчання та викладання, зокрема на формування математичної компетентності учнів, а також визначення перспектив і викликів, що супроводжують цей процес. У роботі застосовано методи аналізу наукових джерел, порівняльний аналіз міжнародного досвіду США, Японії, Китаю, ЄС та узагальнення отриманих результатів. Дослідження показало, що розвиток інтелектуальних навчальних систем у 1970-х роках започаткував ідею персоналізованого навчання, але складність моделювання абстрактних понять обмежувала їхню ефективність. Динамічні геометричні середовища значно розширили можливості візуалізації геометричних процесів, а інтеграція з системами автоматизованого доведення теорем у таких платформах, як GeoGebra та QED-Tutrix, забезпечила формальну перевірку доведень. Окрім того, мобільні додатки, такі як Photomath і Socratic, спрощують розв'язання математичних задач, викликаючи дискусії щодо їхнього впливу на розвиток аналітичного мислення. Іноземний досвід продемонстрував різні підходи до впровадження штучного інтелекту: у США та Китаї активно застосовуються адаптивні платформи (ALEKS, Knewton), віртуальні асистенти (Cognii) та автоматизовані системи оцінювання (Gradescope). У ЄС акцент робиться на етичному використанні нейронних мереж, а в Японії діють обмеження на генеративні моделі у навчальному процесі. В Україні впровадження штучного інтелекту перебуває на початковій стадії, однак розвиваються перспективні ініціативи щодо його інтеграції. Практичне значення дослідження полягає у визначенні перспективних напрямів застосування штучного інтелекту в освіті, що може бути імплементовано у освітні програми математичної підготовки здобувачів як вищої так і загальної освіти. Отримані результати можуть сприяти підготовці педагогів до ефективного використання сучасних технологій та розробці етичних стандартів їх застосування.

Ключові слова: адаптивне навчання; персоналізоване навчання; автоматизоване оцінювання; інтелектуальні навчальні системи (ITS); динамічні геометричні середовища (DGS); системи автоматизованого доведення теорем (GATP)

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Peculiarities of training future specialists in higher education institutions using innovative teaching technologies

Abstract. The rapid technological development of the world opens up new opportunities for higher education institutions, but at the same time presents a series of serious challenges in the context of preparing future specialists. The article aimed to analyse trends in education, and the peculiarities of training future specialists in higher education institutions using innovative teaching technologies. Through a thorough analysis of current research and practical developments in this field, the article emphasised the main trends in educational technologies, including the use of information and communication technologies, artificial intelligence, augmented and virtual reality, Big Data, learning analytics, network technologies, television and video technologies, project-based learning, gamification, microlearning, STEAM education, and others. Six key reasons for the necessity of integrating these technologies into the preparation of teachers in higher education institutions were outlined. The main characteristics of these trend teaching technologies were identified as interactivity, deeper learners' engagement and motivation, possibility of personalisation, active collaboration (including global and networking), facilitation of learners' critical thinking and problem-solving, promotion of their interdisciplinary skills and digital competencies, development of readiness for technological challenges and driving innovation in the classroom in future, full or particular automation, efficiency of the educational process, support for learners' lifelong learning, etc. The results of the study can be used by teachers in the process of developing curricula of educational components, textbooks and manuals, methodological materials that ensure the educational process in a pedagogical higher education institution; updating the content of lecture courses and tasks of pedagogical practice, substantiating new teaching methods in higher education and in the system of teacher training

Keywords: technological approach; digital tools; interactive learning environments; pedagogical techniques; educational advancements; teacher competencies; online platforms

INTRODUCTION

Ukraine's integration into the European educational space, coupled with the ongoing informatisation and digitalisation of higher education, calls for adopting modern approaches to organising the educational process in higher education institutions (HEIs). The relevance of this research topic in

contemporary times is undeniable due to the rapid technological advancements transforming the landscape of higher education. Integrating innovative teaching technologies presents a unique opportunity for higher education institutions to adapt to these changes and enhance the

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preparation of future specialists. With the increasing reliance on digital tools, artificial intelligence, virtual reality, and other cutting-edge technologies, educational institutions need to evolve to meet the demands of both students and the workforce. This study highlights the growing need to modernise educational processes, improve teaching methods, and integrate new technologies that foster greater student engagement, motivation, and critical thinking. In light of the digitalisation of education, innovative teaching methods are not only relevant but necessary for developing the professional competencies of future specialists, particularly in fostering digital literacy, problem-solving skills, and interdisciplinary knowledge.

The formalism and inflexibility in approaches to organising educational, scientific-technical, and innovative activities in Ukraine was highlighted in the Strategy for the Development... (2022). These regulations also emphasised the need to enhance education quality through innovation and to support the professional development of academic staff through the integration of innovative technologies. The contemporary labour market demands specialists who not only possess fundamental competencies but are also equipped with digital skills.

According to K. Novruzova (2024), who explored the possibilities of using information and communicative technologies in higher pedagogical education, the key demand of the modern era is to organise the learning process in educational institutions using completely new, more dynamic and innovative methods. A study on the usage of innovative technologies by educators in higher education by researchers V. Prylypko *et al.* (2024) revealed that only two-thirds of higher education instructors effectively and consistently utilise innovative methods (22% of teachers exhibit a low level of engagement with these technologies, 12% show below-average engagement, 28% demonstrate an average level and 38% exhibit above-average engagement). It underscored the need for enhanced innovative practices in higher education institutions and for fostering future specialists' readiness to incorporate modern teaching technologies into their professional activities. S. Vitvytska's (2024) research on the implementation of the competence approach in the pedagogical training of future teachers in higher education emphasised that readiness for innovative pedagogical activity should be as the outcome of the pedagogical training of specialists. S. Vitvytska understood this readiness as a complex, dynamic, multi-component personal education, consisting of three components: target (professional-pedagogical orientation), basic (pedagogical abilities), and operational (competencies).

According to the findings of a survey conducted by H. Kharkevych *et al.* (2024), a significant majority of teachers, 92% of respondents, affirm the necessity of integrating innovative technologies in the teaching English in HEIs. This integration was seen as crucial for effectively preparing students for their professional careers and ensuring their competitiveness in the labour market. Additionally,

75% of respondents emphasised the importance of fostering students' readiness for the use of innovative technologies in teaching English within HEIs. Authors largely concur with the conclusions drawn by H. Kharkevych *et al.* (2024) regarding the most effective innovative technologies for teaching English in HEIs (interactive learning technology, distance learning, multimedia technologies, virtual environment technology, and microlearning technology). However, it is important to note that distance learning is more accurately described as an educational mode or approach to education rather than a distinct technology. T. Hulko & B. Romanenko (2024), studying the question of quality training of future specialists in HEIs, named innovative forms and methods of learning that allow the use of new teaching technologies, namely: contextual, remote, game, problem-based, modular learning, full assimilation of knowledge. Therefore, the question of identifying the status of some innovations as technologies, forms, or methods is open now and important to clarify in educational discourse.

Taking into account the peculiarities of the professional training of future specialists in the conditions of mixed learning in HEIs, V. Pugach (2024) characterised the most promising technologies of distance learning, including: gamification of the process of professional training of future specialists, quest technologies, cloud-based learning technologies, intelligent information systems in education, mobile learning technologies, immersive technologies. But in authors' opinion, the following modern technologies should be added: artificial intelligence and adaptive learning, virtual and augmented reality, blockchain in education, learning analytics, microlearning, and also such tools as online educational resources and platforms, etc.

I. Knysh *et al.* (2023) identified the main innovative technologies leading in education (problem-based learning technology, modular learning technology, business game technology, situational modeling technology, developmental learning technology, interactive learning technologies, case technology, collective and group learning technology, etc.), but authors of this study consider collective and group learning technologies mostly as forms of learning. As A. Tkachenko (2024) stated, exploring new approaches and teaching technologies, that there are enough examples of successful implementation of innovations in higher education both worldwide (Stanford – Stanford Online platform; Harvard – “Digital Learning” project; University of London – “Coursera Partnership” project; Duke University – “Duke Innovation & Entrepreneurship Initiative” programm; MIT Media Lab. – Project “Learning Initiative”) and in Ukraine (Taras Shevchenko National University of Kyiv – project “Virtual University”; National University “Lviv Polytechnic” – innovative laboratories).

The outcomes of the pedagogical experiment, conducted by I. Savytska *et al.* (2024) at the Higher Education Institution “Podolsk State University”, show that using electronic educational resources (Google digital tools, Moodle, and Zoom platforms) is of great importance

and contributes to the improvement of the professional training of future specialists. The authors of this experimental work emphasised that integrating innovative educational technologies helps the applicants of higher education obtain knowledge accessibly and comfortably, improve their self-study skills, maintain constant contact with the course leader, receive consultations, and participate in scientific research work. Despite these researches on implementing innovative educational technologies in training future specialists in HEIs, further investigation is still required. Thus, the objective of the article was to provide a theoretical justification and synthesis of the distinctive peculiarities of preparing future specialists in higher education institutions through the application of innovative teaching technologies.

MATERIALS AND METHODS

This study utilised a combination of research methods to analyse the integration of innovative educational technologies in higher education. A comprehensive review of contemporary literature was conducted to assess current trends and practices in the use of innovative tools and technologies in high school educational process. This review also explored the specifics of various technological platforms and resources in enhancing the educational experience. This review also investigated the specifics of various technological platforms and resources in improving the educational experience. In addition, the authors of the article shared their own practical experience and beliefs about the use of the latest teaching methods in teaching at a higher education institution, namely Hryhorii Skovoroda University in Pereiaslav (HSUP). The collected data and analysis of the experience of using online resources and modern educational technologies allowed us to gain insight into the implementation and role of innovative teaching tools. The analysis of these responses helped to understand the impact of these technologies on student motivation and engagement, improving their learning outcomes, and developing and updating their professional competencies.

Based on the review of modern scientific literature, analysis of the essence and specifics of the functioning of innovative technologies in higher education, and the authors' practical experience, authors of this article have established the role of such innovations in the development of professional competencies of future teachers and systematised the key reasons why integrating these technologies into teacher training in higher education institutions is essential. Synthesis made it possible to summarise the results and formulate a list of peculiarities of training future specialists in higher education institutions using innovative teaching technologies. In addition, comparative analyses were conducted between traditional teaching methods and the use of innovative technologies, which allowed us to identify the advantages and disadvantages of such approaches. The study of the effectiveness of the use of modern tools in teaching revealed a link between the active use of digital resources and an increase in students'

interest in the learning process, their ability to learn independently and think critically. Also, based on the results of the study, the main barriers and difficulties that may arise when introducing innovative technologies into the educational process were identified, and recommendations were formulated to improve the training of future specialists using innovative technologies.

RESULTS AND DISCUSSION

Information and communication technologies (ICT) play a crucial role in training future specialists in higher education institutions within a blended learning environment. In addition to traditional multimedia tools (such as electronic libraries, catalogs, textbooks, manuals, dictionaries, encyclopedias, simulators, testing programmes, and educational resources available on the Internet), modern technologies also include interactive tools like maps, atlases, conferences, competitions, research works and projects, distance courses, and interactive whiteboards, projectors. Other key technologies include modelling tools, virtual reality (VR) or augmented reality (AR), and networking technologies, as well as Google services (e.g. Google+ social platform, Google Apps for educational institutions – Gmail, Google Calendar, Google Talk, Google Docs, Google Sites, Google Video, Google Forms), etc.

The information and communication technologies integration in higher education contributes to the development of students' ability to work with information, and improve communication skills and creative abilities. Additionally, it supports the formation of theoretical, creative, and modular reflective thinking. The use of ICT not only expands the potential of the educational process but also ensures the education effectiveness, prepares younger generations for life in the information space and enables the development of student's creative potential. ICT can produce significant results only when there are generations of teachers who are ready and willing to use modern means in curricular and extra-curricular activities, and when there are methodists who can develop a methodology for using them in the educational process, including the significant number of examples based on which even a peripatetic teacher can use a computer.

In the context of martial law and the introduction of distance and blended learning, the use of electronic educational resources, computer interactive systems, and interfaces in the training of higher education students is relevant. In particular, when teaching pedagogical courses at Hryhorii Skovoroda University in Pereiaslav, the following asynchronous and synchronous interaction tools are used to intensify and enhance learning: Moodle, Google Classroom, Google Meet, Google Forms, electronic textbooks, audio and video materials, mobile technologies (Viber, WhatsApp), cloud technologies (Google Drive), online whiteboards, task design sites, etc. Lectures and practical classes on MS Teams, Zoom, and multimedia Microsoft PowerPoint presentations (with the possibility of organising higher education students into creative

groups to solve educational problems) have proven to be the most effective forms of teaching educational material. For more effective training of students, recommendations for practical and creative tasks could be presented in the form of videos on the YouTube channel (of the HEI or the teacher's one), the website of the HEI (or a department page), social media pages (Telegram, Facebook, Instagram), e-mail, etc. Popular distance learning providers at HSUP and others are the platforms such as Future Learn, Coursera, Prometheus, and EdEra, etc.

The following modern educational technologies are actively used in the educational process of HEIs: network technology (implemented using local and global networks and allows for interactive interaction of all subjects of the educational process), case technology (educational material is selected and compiled by the teacher in advance into a special set and sent to students for self-study), television and satellite technology (implemented using the broadcast of classes on television and/or YouTube), etc.

At HSUP future specialists of the specialty A1 Education Sciences are taught such educational components as "Modern Educational Technologies", "Pedagogical and Management Technologies", "Modern Technologies of Teaching and Education", "Digital Tools in the Educational Activity of a Teacher", the students of the specialty A4 Secondary Education (language and foreign literature (English)) are taught "Information Technologies in Education", "Media Literacy" and "Digital Tools in the Educational Activity of a Teacher". The effective training of higher education students in distance and blended learning at HSUP is facilitated by the quality electronic educational environment of the university, which includes an information portal and institutional repository; free access to Web of Science, Scopus; search engine services and the open scientometric database Google Scholar; universal bibliographic managers Mendeley, EndNote Basic.

The implementation of such and other innovations contributes to the development of a modern educational environment. As the study by A. Kozhevnikova & P. Kozhevnykov (2024) highlighted, that the professional development of future teachers is significantly influenced by the innovative learning environment, which is simultaneously developed due to the innovation activity of students. Yu. Tulashvili (2022) emphasised that future specialists, trained in higher education institutions in fields related to professional functions and activities associated with digitalisation, should acquire essential competencies in various areas. Specifically, this includes methods for analysing and processing large datasets (Big Data) that cannot be handled through traditional methods due to their large volume, in order to obtain new, high-quality knowledge. Furthermore, future specialists should understand the Internet of Things (IoT), which is a modern communication model where objects ("things") use information technologies to interact with each other and their environment. This includes networks of physical devices that provide Internet-based services and mobile apps that use "smart"

machines to exchange information through common management, control, and processing systems.

Other important areas include wearable technologies, which are electronic accessories worn on the human body that exchange data with the global network and other devices, functioning based on the user's movements or environmental changes. Cloud technologies are also essential, enabling distributed digital data processing, where computing resources are provided as online services to internet users. Additionally, cloud computing, which involves applications that operate under an "Infrastructure as a Service" (IaaS) system, is crucial. In this system, users receive basic computing resources (such as processors and storage) and use them to create their operating systems and applications.

Other key areas include sensor technologies, which involve the use of sensors that provide data for applications in industries like manufacturing and medicine, for tasks such as process control, diagnostics, intensive care, monitoring, and security. Future specialists should also be familiar with social networks, which are software services and platforms for interaction among people in groups, enabling users to create and share public or semi-public content and maintain connection lists. Mobile systems and network administration are also important, as they involve managing mobile internet systems with special computer algorithms that create ways to receive and provide information flow through internet communications.

The development of applications (apps) is another critical area, which involves creating native and cross-platform apps. Native applications are developed for specific platforms or devices, while cross-platform apps can run on multiple systems by adapting the source code. Robotics is another important field, which involves technologies for automating complex processes through robotics. Finally, additive manufacturing (3D printing) is an essential area, involving the creation of three-dimensional objects by superimposing successive layers of material based on a digital model. Scientists S. Palamar & L. Nezhyva (2023) emphasised the effectiveness of various digital technologies in training future specialists, particularly for:

- creating mind maps for interactive lessons – Mind Meister;
- presenting educational material – Google Presentation, PowerPoint;
- visualising educational topics, concepts, rules, experiments, story plots, actions of characters, communication situations, etc., in comic book frames – Comic Master, StoryboardThat;
- visualising thematic content using a word cloud – WordArt;
- producing didactic tools for teaching with the help of infographics – Canva;
- organising educational activities and preparing WebQuests using a virtual whiteboard – Padlet;
- preparing interactive tasks – Learningapps;
- online testing – Kahoot!.

It should be added that the use of comics based on electronic resources such as Pixton has also gained popularity in the process of training future specialists in HEIs. In this study, authors of this article emphasised blockchain technology, the distributed digital registry of decentralised network storage, which allows any number of participants to create a secure network where programmes and information are virtually impossible to fake or destroy. In other words, a blockchain is a chain of data blocks (texts, images, videos, software applications) that are linked to each other and stored as identical copies on many different computers. This technology can be used in the educational process in HEIs for final and intermediate assessments, including student knowledge evaluation (such as pass/fail assessments, exams, and qualification works/thesis defences). According to D. Verbiivskyi (2023), blockchain technology is one of the most reliable, proven and secure ways to record, store, and use the results obtained. Moving away from paper documents is quite possible in the digital educational environment.

In the context of this study, attention should also be given to game-based learning technologies, which have become increasingly popular among students. Game technologies are an integral part of modern pedagogical technologies that help enhance the professional training of future specialists in HEIs. Three key functions of game technology were identified: educational (the development of general learning skills), developmental (the enhancement of various mental functions), and formative (the cultivation of personality traits and general culture). Thus, game technology is a system of methods and techniques employed by future specialists, designed to achieve a specific goal and focused on fostering enduring personal qualities in higher education students through active game-based interaction.

It should be noted that the presence of clear stages and sequence of organisation and application of game technologies is one of the main features and a prerequisite for high-quality practical training of future specialists. N. Onyshchenko (2021) stated that a clear structure, understandable for perception, samples of initial instructional documents and experience in the use of game technologies in higher education make it easier for students to independently design and implement these technologies during their pedagogical practice and in their future professional activities.

In the training system for future specialists, it is important to focus on pedagogical games. According to N. Machynska (2013) these games offer several advantages: they stimulate students' curiosity in finding solutions to professional and educational problems within the game environment; they foster greater interest in interpersonal interaction, promote personal development (when used optimally, they can generate long-term interest in self-improvement and the discovery of one's potential); facilitate the introduction of new communicative and behavioral norms; they help students recognise the unique aspects of their own lives, and create a sense of connection to

the world as a whole. The scientist adds that pedagogical games also encourage a better understanding and learning to use the complexity of psychological, social, and organisational communication processes between students; they contribute to the acquisition of experience similar to what students will apply in their professional lives; they motivate game participants to develop specific personal skills necessary for group learning processes; they balance the activity of all students, as even passive group members are engaged in the process (the game providing students the opportunity to solve complex problems rather than remain passive observers); they reduce participants' anxiety (especially at the initial stage of work); they help alleviate certain defensive mechanisms (as instructions and adherence to group norms allow for the modeling of complex behavior patterns during the game); as a result, they can even facilitate changes in the participants' life attitudes (they may become more tolerant of others' opinions and value orientations, and their self-perception may change, among other things). Thus, given the significant advantages of pedagogical games, authors state that their use should be integrated into the practices of higher education.

Game technologies play a crucial role in shaping the educational and professional motivations, interests, and needs of future specialists. They also serve as a powerful tool for influencing students' intellectual and emotional development. These technologies help increase motivation, foster independence and initiative, enhance communication skills, and stimulate the development of practical skills and competencies in higher education students. The specificity of game technologies lies in the fact that they rely on the mechanisms of game activity, the actualisation of emotional content associated with identification with a certain role, active interaction, and achievement of individual and general outcomes. When teaching, it is advisable to use business games (reproduction of the subject and social specifics of a particular activity), role-playing games (acting out certain life roles), Talk Show technologies (structured discussions in which all participants take part), exercise games (consideration of various situations), etc. Business games play a special role in the context of training future professionals, as they improve the quality of their professional competence. Specifically, business games contribute to the growth and enrichment of students' potential, including theoretical knowledge in their field, personality traits, behavioral patterns, and work practices – elements they will apply in their future professional endeavors. Various modifications of business games are often identified: "Business Theater", simulation games, role-playing games, psychodrama and sociogram, exercise games, and "Talk Shows". The modern form of business games is computer games. Thus, certain types of business games facilitate the playing of business roles related to future professional activities. It should also be mentioned that in the study of pedagogical disciplines it is effective to use dramatisations as role-playing games in which students communicate in pairs with each other or in groups. This makes the class

more diverse, allows students to show independence, and realises communication skills and speech skills. They can help each other, and successfully correct the statements of their interlocutors, even if the teacher does not give such a task. Another effective tool is the Talk Show, a structured discussion in which all students participate. Scientist O. Rogulska & O. Tarasova (2019) stated that Talk Shows allow the teacher to control the course of communication, evaluate the participation of each higher education student in order to acquire the skills of public speaking and discussion, expressing and defending their own position, and forming civic and personal activity.

Project-based technologies contribute to the high-quality professional training of future specialists in higher education institutions. These technologies are aimed at solving specific problems by students, which involves, on the one hand, the use of various teaching methods and tools, and on the other hand, the integration of knowledge and skills from different fields of science, technology, and creativity. The results of project work should be substantial: if it is a theoretical problem, a specific solution should be provided; if it is a practical one, a concrete result ready for implementation should be done. Project-based technology involves the use of a range of research, exploratory, and creative methods, techniques, and tools by the instructor. It should be noted that the ability to utilise project-based technology is an indicator of a teacher's high qualifications, innovative thinking, and focus on the personal and professional development of students during the learning process.

Internet projects are popular in the process of training future specialists; their aim is to enhance the speech skills of higher education students and help them learn to acquire significant amounts of information. There are two types of projects, with significantly different planning, execution, and results: www-projects and E-mail projects. The former focuses on developing the ability to find information on the Internet and present the results, while E-mail projects improve written communication skills. Authors completely agree with the research made by The Association for Educational Communications and Technology (Bui, 2024), which had identified the most common current trends in educational technology:

- Video-assisted Learning, which is a type of learning with the accessibility of content through digital displays, and animated videos to improve students' outcomes and reduce teachers' workload;

- Blockchain Technology (Distributed Ledger Technology, DLT), which is a data storage technology used in Massive Open Online Courses (MOOCs) and e-Portfolios to verify skills and knowledge, solve the problems of authentication, scale, and cost of e-learning, and can also help graduate students publish their achievements at the stage of job search;

- Big Data, which is gathering and analysing learner data that meets the needs of students and personalises the educational process by expanding information on, for

example, course topics, student enrollment, student performance (time per course, completion, test results), and student feedback (rating, surveys);

- Artificial Intelligence (AI), that can automate key activities in education (grading, tutoring, providing feedback between teachers and students, tracking students' progress), enhancing in-class teaching and learning, and preventing possible learning problems, etc.;

- Learning Analytics, using data allows teachers to understand and analyse student learning outcomes to optimise learning (for example, to determine what type of information (text, images, infographics, or videos) is popular among students and should be used more, which pieces of educational information need to be repeated and systematised, which students require additional attention due to academic or behavioral problems, etc.), identify challenges, and improve teaching strategies;

- Immersive Learning with Virtual Reality (VR) and Augmented Reality (AR), which help create interactive, experiential learning, and could be particularly useful for explaining complex concepts that cannot be demonstrated to students by simple images or even hands-on experiments in the lab;

- STEAM Education is a trend that applies significant Science, Technology, Engineering, Art, and Maths content to solve real-world problems through hands-on activities and creative design; it enables students to take a greater interest in the world around them, express and implement their ideas, think outside the box, and collaborate better with others;

- Edutainment (the combination of education and entertainment) is an innovative technology that combines entertainment methods (cartoons, gifs, images, audio, special animated training videos, digital educational entertainment platforms, etc.) and active learning to create an effective balance between information and entertainment, encouraging lifelong learning;

- Gamification, which is integrating game elements that allow students to learn and practice in games, and teachers to boost engagement and create a positive learning environment;

- Microlearning, which is the most prevalent trend in educational technology that focuses on short learning units accessible anytime and anywhere, using interactive content to engage students.

Moreover some of these trends may be joined easily and used together effectively, for instance, VR or AR plus gamification; STEAM plus microlearning; microlearning plus VR or AR; gamification plus edutainment, etc.

L. Emerson & Z. Berge (2018) explained that microlearning is much more than just small chunks of just-in-time learning delivered in media-rich formats to a variety of mobile devices. According to O. Fedorova *et al.* (2022) microlearning was stated as a modern educational and methodological approach involving learning management systems and social networks, which provides students with access to tasks, discussion topics and educational content thematically dosed, in specific situations, under control of

the instructor. Authors of this article formulate the concept of microlearning as an educational technology that enables educators to provide learners with educational micro-modules with interactive, structured content and tasks, utilising learning systems and social networks to engage learners.

Emphasising the importance of incorporating the mentioned modern educational technologies, such as such as AI, VR/AR, ICT, Big Data, learning analytics, network technologies, TV/video-based technologies, project-based learning, gamification, microlearning, STEAM-education, blockchain, edutainment, and others, authors state that these trend technologies not only reshape the way teaching is delivered but also offer new opportunities for future educators to enrich their further pedagogical activity. This leads us to the fact that "future teachers should not only acquire theoretical knowledge during training but also be able to apply it in practice creatively and carry out innovative professional activities, effectively using the latest learning technologies", raised by N. Onyshchenko & N. Serdiuk (2023). This perspective motivated us to identify the key reasons why integrating these technologies into teacher training in HEIs is essential:

1. The use of innovative teaching technologies greatly enriches the educational process and motivates learners to study, enabling more interactive, interesting, and personalised lessons, for instance, VR/AR allows for immersive experiences that bring abstract concepts to life; AI, ICT, and network technologies help teachers to tailor the learning experience to suit individual student needs, automate assessments, and incorporate multimedia to boost engagement, etc.

2. They help teachers to adapt future educators to technological change and digital challenges, by equipping them with the necessary knowledge and digital literacy to creatively integrate these tools into their further teaching and foster an innovative classroom environment. For instance, technologies like Learning analytics and Big Data provide valuable insights into student progress, allowing for personalised and adaptive teaching.

3. They promote critical thinking and problem-solving, fostering an environment where students actively engage with the material. For instance, case- and project-based technologies help teachers to create real-world scenarios that challenge students to apply their knowledge and innovate, encouraging deeper understanding and creative solutions.

4. They can foster interdisciplinary skills, helping students understand how different fields intersect and enhancing their ability to think across disciplines. For instance, using VR or AR in STEM subjects provides hands-on learning opportunities, which allow students to experiment with concepts in a tangible, interactive manner.

5. They allow teachers to make the personalisation of learning possible. For instance, the use of AI and Learning analytics can create individualised learning paths that accommodate different learning styles, ensuring each student can learn at their own pace.

6. Integration of these technologies can foster a culture of lifelong learning, equipping students with the skills needed to adapt to new challenges throughout their careers.

Therefore, integrating these cutting-edge educational technologies into training programs in HEIs can not only enhance the quality of education but also ensure that future educators can apply their knowledge creatively and effectively. Scientist A. Tkachenko's (2024) also highlighted the advantages of using those key innovative technologies, including enhances accessibility and flexibility of learning, the facilitation of the integrating theoretical knowledge with practical application, the ability to tailor the educational process to meet the individual needs of students, the increase in student motivation, and the promotion of creativity and critical thinking. In addition to these benefits they also identified several disadvantages and potential risks, such as the high cost of equipment, data security issues, and the necessity of adapting curricula to accommodate new conditions. The authors of the article agree with A. Tkachenko that such strengths collectively enhance student participation, improve learning outcomes through advanced technologies, and provide flexible learning options for students with diverse schedules and commitments. However, it is important to note that A. Tkachenko did not give enough attention to how addressing the weaknesses and maximising the opportunities can play a key role in overcoming current challenges and advancing the potential of innovations in higher education. Comparing authors' research results and outcomes of A. Tkachenko's (2024) research, it is important to underline the point of view towards the strengths of innovations in higher education (increased motivation and student engagement, improved quality of education, and convenience and accessibility of learning), the weaknesses (technical and financial limitations and the training of teachers and students for using advanced technologies), and the opportunities (expanding access to quality education and promoting the development of critical thinking and problem-solving skills through interactive learning methods).

It is also worth adding the laws of Ukraine related to the integration of innovative technologies into the educational process. In particular, the Law of Ukraine No. 1556-VII (2014) regulates the organisation of higher education in Ukraine and defines the legal framework for its development. One of the key provisions of this law is to promote the development of scientific and innovative activities in educational institutions. The Law of Ukraine No. 40-IV (2002) lays down the legal framework for the development of innovation in Ukraine. In the context of education, it plays an important role in promoting the use of new technologies and teaching methods. The Law of Ukraine No. 2807-IX (2022) regulates the process of informatisation in Ukraine and ensures the introduction of information and communication technologies in various fields, including education. Thus, all these legislative acts interact to create a favourable environment for innovative changes in education, in particular for the training of future

specialists using innovative technologies. They contribute to the development of intellectual and digital competences of students, which is essential for training professionals capable of working in a rapidly changing technological and information environment. This integration of innovative technologies into the educational process also helps to increase the competitiveness of graduates in the labour market, providing them with access to modern knowledge and skills that meet the requirements of a globalised economy. Moreover, as L. Slipchychyn *et al.* (2024) stated, the digitalisation of educational processes opens up new opportunities for improving the quality of education by updating competencies in response to contemporary challenges, which is critically important for Ukraine's post-war reconstruction.

Training future specialists in HEIs through innovative teaching technologies is crucial for preparing educators to meet the demands of a rapidly evolving educational landscape and has several peculiarities, namely: interactivity, deeper learners' engagement and motivation, possibility of personalisation, active collaboration (included globally and networking), facilitation of learners' critical thinking and problem-solving, promotion of their interdisciplinary skills and digital competencies, development of readiness for technological challenges and driving innovation in the classroom in future, full or particular automation, efficiency of the educational process, support for learners' lifelong learning, etc. By integrating innovative teaching technologies in training students in HEIs, future educators can be better prepared to teach in a modern technology-driven world and equipped with the knowledge and competencies to thrive in their careers.

CONCLUSIONS

Therefore, in the context of informatisation and digitalisation of higher education, innovative teaching technologies

are extremely relevant. The use of innovative technologies in the professional training of future specialists in higher education institutions contributes to the formation of their information and technology competence, digital literacy, creative skills, culture, desire and ability to work together, determine their trajectory of self-education and realise their educational needs; and the formation of a harmoniously developed, socially active, and nationally conscious personality of a future specialist, a professionally competent and creative specialist who combines high spirituality, morality, and professional competence. A clear structure, understandable for perception, samples of source instructional documents, and experience in implementing innovative technologies in higher education facilitate students' independent design and implementation of these technologies during their pedagogical practice and in their future professional activities.

In addition to considering the peculiarities of training future specialists in HEIs through innovative teaching technologies, it is important not only to focus on the prospects for their implementation but also to acknowledge the potential challenges and risks associated with their adoption, especially in times of war. Prospects for further research could be the study of forming the readiness to use innovative technologies in the practical activities of future teachers of various specialties in the context of global humanistic trends; and comparative studies of using modern teaching technologies in the educational process of Ukraine and the European Union.

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CONFLICT OF INTEREST

None.

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Особливості підготовки майбутніх фахівців у закладах вищої освіти засобами інноваційних технологій навчання

Анотація. Швидкий технологічний розвиток світу відкриває нові можливості для закладів вищої освіти, але водночас ставить перед ними низку серйозних викликів у контексті підготовки майбутніх фахівців. Метою статті було проаналізувати тенденції в освіті та особливості підготовки майбутніх фахівців у закладах вищої освіти за допомогою інноваційних технологій навчання. Завдяки ретельному аналізу сучасних досліджень і практичних напрацювань у цій сфері, стаття виокремлює основні тренди серед освітніх технологій, зокрема використання інформаційно-комунікаційних технологій, штучного інтелекту, доповненої та віртуальної реальності, Big Data, аналітики навчання, мережевих технологій, телевізійних і відео-технологій, проєктного навчання, гейміфікації, мікронавчання, STEAM-освіти тощо. Виокремлено шість ключових причин, що зумовлюють необхідність інтеграції зазначених технологій у підготовку педагогів у закладах вищої освіти. Виявлено основні особливості трендових технологій навчання, зокрема інтерактивність, глибше залучення та мотивація учнів, можливість персоналізації, активна співпраця (в тому числі глобальна та мережева), сприяння критичному мисленню та вирішенню проблем, розвиток міждисциплінарних навичок і цифрових компетенцій, розвиток готовності до технологічних викликів і застосування інновацій у майбутньому, повна або часткова автоматизація, ефективність навчального процесу, підтримка навчання впродовж усього життя тощо. Результати дослідження можуть бути використані викладачами в процесі розробки робочих навчальних програм освітніх компонентів, підручників і навчальних посібників, методичних матеріалів, що забезпечують освітній процес у педагогічному закладі вищої освіти; оновлення змісту лекційних курсів і завдань педагогічної практики, обґрунтування нових методик викладання у вищій школі й у системі підвищення кваліфікації вчителів

Ключові слова: технологічний підхід; цифрові інструменти; інтерактивні освітні середовища; педагогічні методики; освітні нововведення; компетенції вчителя; онлайн-платформи

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