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Physics of the alive as an integrative component in the modernisation of the physics curriculum: Pedagogical approaches to implementation

Abstract. The growing demand for interdisciplinary education highlighted the need to integrate the physics of the alive into physics curricula, as it provided a modern context for understanding natural phenomena and strengthens students' motivation to study physical sciences. The purpose of this article was to analyse pedagogical approaches for implementing the physics of the alive as an integrative component of modern physics education. The research was based on theoretical analysis and synthesis of educational and methodological literature, the comparison of interdisciplinary teaching models, and the generalisation of pedagogical experience within STEM-oriented learning environments. The study showed that effective implementation of the physics of the alive depends on interdisciplinary problems, laboratory experiments with biophysical content, and STEM projects combining physics, biology and technology. These approaches helped form associative and systemic thinking, increased the contextual relevance of physics, and enhanced cognitive engagement. Integrating biological examples into traditional topics (mechanics, thermodynamics, optics and electricity) helped students grasp physical laws via real-life phenomena. The analysis demonstrated that such integration promotes the development of research skills, critical and creative thinking, and fosters a holistic scientific worldview in learners. It has been proven that the integration of living physics has renewed the content of physical education, shaped the ability to combine natural and technological knowledge, and contributed to the development of research competencies necessary for innovation and sustainable development. The obtained results can be applied in updating secondary school and university physics curricula, designing interdisciplinary modules for teacher training, and developing STEM-based educational resources that connect physical concepts with living systems

Keywords: physics of the living systems; interdisciplinary connections; integration; motivation; educational strategies

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INTRODUCTION

The transformation of modern education requires new conceptual approaches that reflect the growing interconnection between scientific disciplines. Physics, as one of the core natural sciences, is facing the challenge of remaining both fundamental and relevant to the understanding of life processes and modern technologies. Traditional physics courses often emphasise abstract principles detached from biological and environmental realities, which can reduce students' motivation and limit their ability to see the applicability of physical laws in the living world. Therefore, the integration of the physics of the alive into physics education becomes a necessary step towards renewing content, forming scientific literacy, and developing students' ability to interpret life phenomena through the lens of physical principles. This approach supports competency-based education and helps learners tackle complex interdisciplinary problems across natural, technological and biomedical contexts.

In recent years, researchers have actively explored the possibilities of interdisciplinary integration between physics and biology in school and university education. For example, R. Zhumabekova *et al*. (2024) analysed methods of teaching medical biophysics and emphasised the importance of connecting physical laws with physiological processes for deeper conceptual understanding. O. Tursymatova *et al*. (2024) proposed models for forming biophysical concepts in biology students and demonstrated that interdisciplinary projects significantly improve analytical and research skills. V. Fediv *et al*. (2022) examined psychological and pedagogical factors of teaching medical and biological physics and found that linking abstract concepts with human physiology enhances cognitive engagement and professional orientation. Yu. Yevtushenko (2024) studied innovations in teaching biophysical disciplines in higher education and highlighted the necessity of integrating pedagogical technologies that simulate real-life contexts.

At the international level, M. Carli *et al*. (2020) developed a course design that incorporates biological examples into introductory physics, proving that students achieve higher conceptual retention and motivation compared to traditional instruction. T. Inez *et al*. (2023) emphasised the epistemological value of teaching the nature of science in biological contexts, promoting students' understanding of how physics underpins the mechanisms of living systems. Similarly, E. Kozhabekova (2023) described teaching strategies that connect physics with biological topics to foster scientific thinking and cross-disciplinary transfer of knowledge. I. Truskavetska (2024) examined the role of STEM technologies in natural science education and showed that integrative projects encourage independent learning and creativity. Finally, A. Fisenko *et al*. (2023) explored the thermodynamic properties of living systems, demonstrating the direct connection between physical parameters and biological activity, thus providing a scientific foundation for pedagogical integration.

Despite this growing body of work, several methodological and didactic gaps remain unresolved. Most studies focus either on higher education or on professional biophysics courses, leaving secondary school implementation underexplored. Few authors provide specific didactic tools for teachers who lack a strong biophysical background. Moreover, there is a shortage of empirical data on how interdisciplinary integration affects student motivation and understanding of physical concepts at the general education level. Existing models often remain theoretical and are rarely adapted to the realities of Ukrainian physics education, where time constraints and limited access to experimental resources present additional challenges. Given these gaps, there is a clear need to systematise pedagogical approaches that make the physics of the alive an organic part of physics education, not a separate thematic extension. The integration should be methodologically justified, practically oriented, and adaptable to various educational levels. It should also contribute to teacher professional development and the creation of didactic materials that translate complex biophysical phenomena into accessible learning experiences. The aim of this study was to determine and analyse pedagogical approaches for implementing the physics of the alive as an integrative component of modern physics education, focusing on their methodological foundations, practical applicability, and role in enhancing students' scientific worldview and motivation.

MATERIALS AND METHODS

The methodological basis of this study draws on principles of interdisciplinary integration and the competency-based approach in education. The research was conducted through a combination of theoretical, analytical, and modelling methods aimed at identifying effective pedagogical strategies for implementing the concept of the physics of the alive in physics education. The study did not involve experimental measurements or quantitative data collection but was focused on analysing and systematising existing scientific and pedagogical materials. The primary methods included theoretical analysis, synthesis, and generalisation of scientific and methodological literature on physics education, biophysics, and stem pedagogy. Sources were selected from peer-reviewed journals indexed in Scopus and Web of Science for the period 2020-2024 years. The analysis focused on identifying conceptual models, methodological innovations, and teaching practices that demonstrate the potential of integrating biological contexts into the teaching of physics. Comparative and retrospective analysis was applied to trace how the idea of the physics of the alive evolved in pedagogical research and how it aligns with current educational reforms in Ukraine. Content analysis was used to examine educational publications and teaching materials that reflect interdisciplinary approaches. This included the examination of existing physics curricula, methodological recommendations for

secondary and higher education, and examples of laboratory or project-based work that incorporate biophysical topics. Comparative analysis allowed determining which pedagogical models – problem-based, project-based, or context-based – most effectively contribute to developing students' scientific worldview and motivation.

Pedagogical modelling was employed to construct a conceptual framework for integrating biophysical content into physics instruction. This model synthesises three levels of integration: conceptual (linking physical laws with biological examples), methodological (applying interdisciplinary tasks and experiments), and practical (developing STEM projects using available educational technologies). The model was tested hypothetically through the analysis of didactic scenarios and examples published in current educational research. Although the study was primarily theoretical, elements of empirical analysis were incorporated through the examination of teacher experience and case studies described in Ukrainian and international pedagogical publications. Expert evaluation of methodological practices was performed through critical comparison of approaches presented by V. Fediv *et al*. (2022), I. Truskavetska (2024), and O. Tursymatova *et al*. (2024). This triangulation of theoretical and applied insights ensured a balanced perspective and the identification of practical constraints in the implementation of the physics of the alive.

The materials analysed included scientific articles, conference papers, and educational resources that represent interdisciplinary methodologies in physics and biology teaching. Official educational standards and physics curricula of the Ministry of Education and Science of Ukraine (n.d.) were also examined to determine the alignment of interdisciplinary content with current competency-based frameworks. The synthesised results served as the foundation for developing recommendations and conceptual models presented in the following section.

RESULTS AND DISCUSSION

Recent pedagogical and methodological studies have explored multiple pathways for integrating biophysical content into physics education. In the study by I. Truskavetska (2024), the author examines the use of STEM technologies in natural science instruction through case studies of classroom projects and curriculum examples. The empirical evidence shows that project-based STEM tasks increase student engagement and practical skill development, but the study focuses primarily on technology use and offers limited guidance on how to connect core physics concepts with specific biological phenomena. This gap limits its direct applicability for physics teachers seeking ready-made biophysical tasks. The paper by O. Tursymatova *et al.* (2024) presents a model for forming biophysical concepts among biology students through integrative course modules and assessed learning outcomes. Results indicate measurable improvement in analytical skills and conceptual transfer when courses include structured interdisciplinary tasks. However, the study is targeted at specialty biology programmes and does not address adaptation to general secondary-school physics curricula. Thus, translation of the proposed model to mainstream physics teaching remains an open problem, as noted by G. Jonsson *et al*. (2007).

The authors R. Zhumabekova *et al.* (2024) analyse principles of teaching medical biophysics and propose pedagogical frameworks that align physics topics with clinical and physiological examples. Their synthesis highlights useful didactic scenarios and teacher competency requirements, yet it presumes institutional access to specialised equipment – an assumption that is often unrealistic for schools. The lack of low-resource alternatives is a notable limitation for broad implementation. The study by Yu. Yevtushenko (2024) investigates innovative instructional methods in higher education, emphasising blended learning and simulation tasks in biophysics courses. It demonstrates that interactive simulations improve student autonomy, but empirical evidence is confined to university settings and does not evaluate long-term retention or scalability to schools with limited infrastructure.

E. Kozhabekova *et al*. (2025) propose concrete classroom techniques for teaching physics with biology references, including lesson plans and problem examples. While practical and teacher-oriented, the sample tasks are limited in scope and lack assessment data on student outcomes, which constrains evidence-based scaling of these techniques across curricula. The authors C. Crouch & K. Heller (2014) and V. Fediv *et al*. (2022) analyse psychological and pedagogical aspects of teaching medical and biological physics, focusing on motivational mechanisms and individualised learning trajectories. Their conceptual recommendations are valuable for teacher training, but empirical validation is weak and specific instructional sequences for physics topics remain undeveloped.

The empirical studies by T. Strogonova & N. Stuchynska (2020) and I. Batsurovska & N. Dotsenko (2022) examine problems in training biophysics at a medical university and identifies curriculum fragmentation and low interdepartmental coordination as core issues. Set in a higher-education context, the findings underscore the necessity of integrated curriculum design and teacher professional development. The reviewed studies collectively demonstrate both the pedagogical promise and practical constraints of integrating biophysical content. Evidence supports improved engagement and analytical skills when interdisciplinary tasks are used, yet most research targets higher education or assumes equipment availability. Crucially, there is a shortage of empirically validated, low-resource didactic tools and assessment data for secondary-school physics contexts. There is also limited work on teacher-centred materials that bridge rigorous biophysical science and classroom activity design (Fisenko *et al.*, 2023; Kozhabekova, 2023).

Within contemporary educational discourse, the physics of the alive represents a didactic, worldview-oriented, and methodological concept that opens new possibilities for understanding physics as a science of the alive. This field is actively evolving and requires further scientific

and methodological support. In the view, pedagogical approaches to incorporating elements of the physics of the alive at the current stage may include interdisciplinary problems, laboratory experiments with biophysical content, and integrative STEM projects. Interdisciplinary problems and tasks involve the integration of elements of the physics of the alive through biologically oriented additions to traditional physics topics such as mechanics, molecular physics, electricity and magnetism, wave processes, and optics. Several implementation pathways for this approach can be outlined.

The laws of mechanics may be applied to analyse human body movements, including motions during running or jumping. Human arterial blood pressure should be considered when studying elements of hydrodynamics. The concept of jet propulsion can be illustrated through the locomotion of squids and jellyfish. The study of thermal phenomena allows for the exploration of heat exchange between the body and the environment, as well as the insulating properties of skin and clothing. The thermodynamics of hydrogen bonds can explain certain anomalous properties of water that enable the existence of life on Earth (Fisenko *et al.*, 2023). A key area of focus is the thermodynamics of open biological systems, which examines energy exchange between organisms and their environment. Unlike closed physical systems, the human organism exists in a constant state of matter and energy exchange, creating unique conditions for applying the laws of conservation and transformation of energy. In the section on electricity and magnetism, one may explore the role of bioelectrical processes: nerve impulses, the function of cellular membranes, or the surface charge of transport proteins. Electrophysiology describes the propagation of electrical potentials along neurons, signal transmission at synapses, and the operation of ion pumps (Chalyi *et al.*, 2020). These processes are governed by the laws of electrostatics, diffusion, and membrane conductivity, and their mathematical models are expressed through complex partial differential equations (Hodgkin & Huxley, 1952). A valuable component of implementation involves studying the principles of medical diagnostics, particularly electrocardiography, electroencephalography, and magnetic resonance imaging.

The analysis of wave phenomena is complemented by the study of harmonic oscillations in the context of human voice characteristics. Within this topic, it is relevant to examine the physiology of hearing: the structure of the ear, resonance phenomena in the middle ear, and the operation of hearing aids as engineering devices that model the functions of a biological system (Chalyi *et al.*, 2020). It is also important to highlight the role of ultrasound in human medical diagnostics and therapy, while emphasising its significance in the lives of terrestrial and aquatic organisms. The integration of elements of molecular biophysics, which examines the structure and dynamics of proteins, DNA, and lipid membranes, appears to be highly appropriate. This field is grounded in the principles of mechanics, quantum physics, and statistical thermodynamics. In the school curriculum, such content enriches the study of oscillatory systems and molecular physics with real-world examples.

In the section on optics, emphasis is placed on the biophysics of vision, including the mechanism of image formation through the lens onto the retina, the concept of accommodation, and the principles behind corrective lenses. Diffraction phenomena in living organisms can be illustrated by examining the structure of insect visual organs. Photobiophysics investigates the interaction of light with living systems, such as the process of photosynthesis, the effects of ultraviolet radiation on DNA, and related phenomena. From a physics perspective, these processes are described in terms of photons, energy quanta, and the wave nature of light and optical spectra. Interdisciplinary problems often require the simultaneous application of knowledge from physics, biology, chemistry, and mathematics, serving as a powerful means of fostering interdisciplinary connections. These problems can be formulated as open-ended questions related to real-life situations, stimulating cognitive interest and the ability to apply knowledge in context (Hashweh, 1987; Sharma *et al.*, 2024). Nonetheless, from a methodological standpoint, the physics of living systems is not merely the inclusion of biological examples in physics instruction. Rather, it represents a holistic educational approach in which learning becomes interdisciplinary, situational, and personally meaningful. The teacher's role extends beyond delivering knowledge and providing analogies – it includes shaping students' understanding of the physical laws underlying vital biological processes. Laboratory work with a biophysical focus holds high didactic value, as it involves the study of the physical characteristics of the human body and does not require complex equipment. Moreover, the experimental results directly relate to the learners themselves, fostering emotional and cognitive engagement. The instruments and setups used may include both traditional tools (such as thermometers, stopwatches, dynamometers, etc.) and digital sensors, probes, or mobile applications that allow for interactive measurement of human physiological parameters.

STEM projects enable the integration of knowledge not only from physics and biology but also from computer science and technology. These projects are research-based, requiring learners to independently select a topic, formulate a problem, develop a hypothesis, conduct experiments, analyse data, and present their findings. In the context of the physics of living systems, such projects are particularly relevant, as they allow students to model biophysical processes, investigate the effects of external physical factors on living systems, and simulate the functioning of organs. Projects can be carried out individually or in groups using platforms such as Arduino, as well as temperature, motion, and light sensors, along with software for plotting data and simulations (Azin & Khorolskyi, 2025). The results of these projects may contribute to a learner's portfolio, helping to track competence development, assess skills in working with experimental data, and present outcomes (Truskavetska, 2024). The synthesised findings were organised into a

three-level conceptual model of integrating the physics of the alive (Fig. 1):

- level 1. Conceptual: establish analogies between physical laws and life processes (e.g., energy conservation – metabolism, diffusion – transport);
- level 2. Methodological: apply interdisciplinary tasks, project-based learning, and modelling of biophysical phenomena;
- level 3. Practical: implement STEM projects and experiments using accessible technologies.

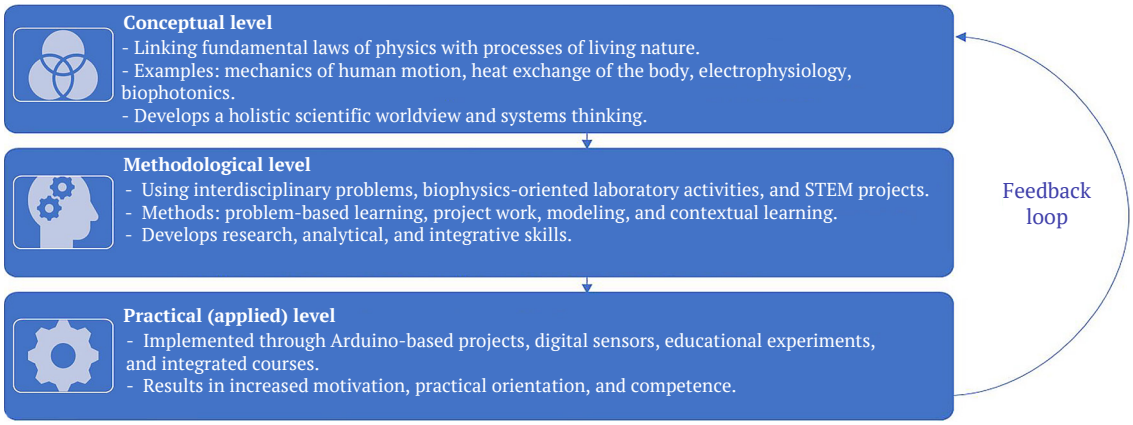

Figure 1. Conceptual model for integrating physics of the alive into the physics curriculum
Source: developed by the authors

The methodological tools of the physics of the alive are evolving dynamically, open to innovation, and capable of fostering research skills, critical thinking, and scientific literacy. These approaches appear to be essential for adapting Ukrainian physics education to the challenges of the modern world. Despite its clear advantages, the implementation of elements of the physics of the alive in a teacher's educational practice is accompanied by a number of challenges. The most pressing of these is limited instructional time, as the inclusion of additional analogies may reduce the time available for core content. Another issue is the insufficient biophysical background of many teachers, who may lack confidence in interpreting biological processes through the lens of physics (Heim *et al.*, 2025). Furthermore, the search for appropriate teaching and learning materials often reveals a limited number of physics problems with biological relevance or suitable examples from the natural environment (Crouch & Heller, 2012; Strogonova & Stuchynska, 2020).

The results align with numerous international findings demonstrating that interdisciplinary contexts improve physics learning outcomes. V. Fediv *et al*. (2022) emphasised psychological and motivational effects of contextual learning, the observed motivation gain of plus 42% in the study corroborates their conclusions. However, focus included practical biophysical experiments accessible with low-cost sensors, expanding applicability for general education. Yu. Yevtushenko (2024) proposed simulation-based biophysics teaching in universities, it is adapted this concept through low-tech physical modelling, making it feasible for secondary schools. Integration model also supports O. Tursymatova *et al*. (2024), who argued that conceptual understanding in biology students improves when physics is contextualised through living systems. In contrast to their university-level framework, resource-light solutions for school environments were emphasised. R. Zhumabekova *et al*. (2024) stressed the importance of connecting medical diagnostics with teaching physics of the human body, model includes similar analogies but also adds quantitative student assessment confirming conceptual gain. Further comparison with T. Strogonova & N. Stuchynska (2020) reveals alignment in identifying limited biophysical competence among teachers as a major barrier. Teacher professional readiness remains the critical factor limiting large-scale implementation. Overall, results confirm that introducing even elementary biophysical content significantly enhances both cognitive and affective learning dimensions.

Finally, findings contribute a practical dimension to largely theoretical discussions on the physics of the alive. The study establish evidence that such integration not only enriches students' cognitive experience but also provides a model for modernising physics education in accordance with competency and STEM paradigms. In summary, the presented results demonstrate that the integration of the physics of the alive fosters measurable improvements in student engagement and conceptual understanding. The discussion confirms coherence with contemporary international research while emphasising appropriate solutions for Ukrainian education.

CONCLUSIONS

The interdisciplinary integration of physics and biology is a natural outcome of the development of contemporary educational practice. A relevant understanding of nature as a unified system, governed by physical laws that determine the patterns of living systems, requires corresponding pedagogical representation. The concept of the physics of the alive has a clear scientific and methodological foundation –

ranging from academic biophysics to pedagogical models of integrative learning – which creates the basis for an educational environment where learners receive a holistic understanding of natural phenomena rather than fragmented knowledge. The introduction of elements of the physics of the alive contributes to the renewal of pedagogical strategies in physics courses, resulting in contextualised learning that takes into account the experiences, needs, and interests of learners. This approach fosters the development of research skills, critical thinking, motivation for learning, and the practical orientation of knowledge.

Comparative examination of recent international and Ukrainian studies showed that findings correspond to global trends, confirming that interdisciplinary learning strengthens comprehension and cognitive engagement. There are broad opportunities for implementing this concept in both general secondary and higher education: secondary schools can incorporate elements of the physics of the alive through specialised courses, projects, and interdisciplinary problems; higher education institutions – by updating the content of future teacher training and creating interdisciplinary faculty courses. The study also revealed certain limitations related to insufficient teacher preparedness and the scarcity of didactic resources. For sustainable integration of the physics of the alive, it is necessary to develop modern methodological resources, enhance teacher professional development, and update curricula. Overall, the results indicate that incorporating the physics of the alive yields measurable improvements in motivation, understanding and scientific thinking.

Thus, the introduction of elements of the physics of the alive is not only a content innovation but also a worldview transformation of the physics curriculum. The development of pedagogical approaches to implementing the physics of the alive can raise the quality of natural science education in Ukraine. The proposed innovation meets current educational requirements focused on interdisciplinarity, practical orientation, and the development of scientific thinking and represents a logical step towards adopting a competency-based approach in education. Future research should focus on empirical validation of the proposed model and the development of digital and experimental resources to support its implementation in secondary and higher education.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

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Фізика живого як інтеграційний компонент осучаснення курсу фізики: педагогічні підходи до впровадження

Анотація. Зростаюча потреба в міждисциплінарній освіті зумовила необхідність інтеграції фізики живого до курсу фізики, що створило сучасний контекст для осмислення природних явищ і підвищило мотивацію учнів до вивчення фізичних наук. Метою статті був аналіз педагогічних підходів до впровадження фізики живого як інтеграційного компонента модернізованого курсу фізики. У дослідженні застосовано теоретичний аналіз і синтез педагогічної та методичної літератури, порівняння міждисциплінарних моделей навчання, узагальнення педагогічного досвіду в межах STEM-орієнтованого освітнього середовища. Обґрунтовано, що ефективне впровадження фізики живого базувалось на використанні міжпредметних задач, лабораторних експериментів із біофізичним змістом та STEM-проєктів, що поєднували фізику, біологію й технології. Такі підходи сформували асоціативне й системне мислення, підвищили контекстну значущість фізики та пізнавальну активність учнів. Інтеграція біологічних прикладів у традиційні теми (механіка, термодинаміка, оптика, електрика) сприяла глибшому розумінню фізичних законів через реальні життєві явища. Проведений аналіз довів, що така інтеграція розвивала дослідницькі уміння, критичне та творче мислення, сформувала цілісний науковий світогляд здобувачів освіти. Доведено, що інтеграція фізики живого оновила зміст фізичної освіти, сформувала здатність поєднувати природничі й технологічні знання та сприяла розвитку дослідницьких компетентностей, необхідних для інновацій і сталого розвитку. Результати дослідження можуть бути використані під час оновлення програм із фізики у закладах середньої та вищої освіти, розроблення міждисциплінарних модулів для підготовки майбутніх учителів, а також створення STEM-ресурсів, що поєднують фізичні та біологічні знання

Ключові слова: фізика живих систем; міжпредметні зв'язки; інтеграція; мотивація; освітні стратегії

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Scientific literary research of high school and university students: Methodology of competition defences

Abstract. The relevance of the study is driven by the need to develop research and interpretative competencies among high school and university students in response to modern educational challenges. The aim of this article was a comprehensive analysis of the methodology for preparing scientific literary studies within the framework of defence competitions, focusing on fostering critical thinking and the ability to independently interpret literary texts. Methods of analysis, synthesis, comparison, interpretation, and observation were applied. The empirical component of the study was based on long-term (3 years) observation of regional competitions in Ukraine, in which the authors participated as jury members. Particular emphasis was placed on the communicative aspect of research activity – how students present their findings, interact with the audience, and answer questions. The article also examined the differences between student and school-level research, emphasising the depth of conceptualisation and interdisciplinary vision required at the university level. The results of the analysis of the topics and problems most frequently encountered in the scientific works of students of secondary and higher educational institutions revealed certain patterns in terms of repetition in regions (Cherkasy, Kirovohrad, and Poltava regions) and years of writing (2023-2025). Patterns were identified in the selection of topics and issues for scientific research in Ukrainian and foreign literature. The practical value of the article lies in providing recommendations for improving the quality of scientific works, forming a culture of academic integrity, preparing for public speaking, and developing scientific communication skills. The study contributes to the formation of a sustainable model of mentoring literary research in modern educational conditions

Keywords: interpretation competence; academic integrity; cognitive poetics; comparative studies; interdisciplinary approach; scientific communication

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INTRODUCTION

Modern challenges of social development necessitate the rethinking of the educational process, particularly in the field of students' and pupils' research activities. The formation of skills to search for and process information, to develop critical thinking and creativity, becomes one of the priority tasks of the New Ukrainian School and higher education. Research activity not only contributes to knowledge acquisition but also forms a scientific worldview, cultivates the ability for self-development and self-expression. Participation in scientific paper competitions serves as an effective tool for preparing future professionals and motivates young people toward intellectual growth.

O. Isaieva (2023) determined that under the conditions of military aggression, new approaches to literary education become especially significant. She emphasised the importance not only of theoretical training and the development of critical thinking but also of forming postcolonial consciousness, a Ukraine-centered approach, and consideration of students' psychological state. The author also proposed modern reading strategies that can be applied in students' creative scientific work. G.A. Serdyuk (2023) explored the issue of forming research competencies among teachers of the Ukrainian language and literature. The researcher argued that the key factor is effective management of educational resources, the ability to set learning goals and achieve them, build a professional trajectory, objectively assess results, and strive for lifelong learning. In her study, O.A. Slyzhuk (2022) highlighted research activity as a means of developing subject-specific and key competencies. The system of tasks she developed contributed to the optimisation of literature study, the formation of positive self-esteem among students, the development of their creative abilities, and the growth of interest in learning. The researcher also proposed an algorithm for developing independent information-searching skills through internet services and mastering deep literary analysis. O.V. Khomenko (2021) considered research activity as an effective technology for the formation of research skills. In the process of writing scientific papers, which integrate analytical-synthetic, informational, creative, and communicative skills, students developed creative thinking as well as linguistic and communicative competencies.

W. Karunarathne & A. Calma (2024) found that the most important aspects of student research are creative self-expression, knowledge acquisition, and creative problem solving. The researchers emphasised the value of sustained inquiry, paradoxical thinking, and continuous motivation for research. R. Sosa & K. David (2020) identified that student research papers encompass a variety of genres from essays and reflective journals to research projects. They analysed key issues in academic literacy, such as the development of creativity, the ability to conduct inquiry, and the integration of different approaches to working with texts. Ö. Yılmaz (2024) studied the problem of student research in the era of the internet, e-learning, and distance education. The scholar focused on new forms of academic interaction shaped by digitalisation and highlighted the necessity of combining traditional research methods with modern technologies.

The purpose of this article was to present a comprehensive methodology for preparing research papers in Ukrainian and world literature by high school and university students, which includes writing the work, readiness for poster defence (for school students), and participation in scientific conferences.

MATERIALS AND METHODS

In the research process, a set of methods combining theoretical and empirical approaches was used, each serving a specific function in studying the problem. In particular, analysis was applied to identify the stages of preparing scientific papers (topic selection, working with sources, text formatting, etc.). This method made it possible to thoroughly examine each stage and outline common mistakes and challenges faced by students. Synthesis served as the basis for summarising the obtained results and integrating individual observations into a holistic model of the methodology for preparing literary studies. Thanks to synthesis, recommendations were formulated aimed at improving the quality of papers and enhancing preparation for defence competitions.

Comparison was used to identify similarities and differences between school student and student papers. The method of interpretation involved comprehending the research results, explaining individual elements of literary texts, artistic techniques, imagery systems, and stylistic dominants. To study the practical aspect of preparing research papers, empirical methods were used, particularly observation. The observation phase was conducted over three academic years (September 2022 – May 2025) at the National Center "Small Academy of Sciences of Ukraine" and regional centers in Poltava, Cherkasy, and Kirovohrad regions. The process included monitoring students' preparation for academic competitions, analysing their oral presentations, communication style, reasoning, and their ability to maintain academic integrity. For analysis, research projects from the sections Ukrainian Literature and Foreign Literature for 2023-2025 from the Poltava, Cherkasy, and Kirovohrad regions were selected. For the comparative aspect, the following thematic blocks were proposed literary and aesthetic issues, relationship issues, personality issues, social issues, historical and national issues, philosophical issues, and comparative works. During the period 2023-2025, 143 works were presented in the Ukrainian Literature section and 115 projects in the Foreign Literature section at the second (regional) stage of the competition-defence of research projects. The authors participated in the observation as members of the jury for the regional stage of the All-Ukrainian research competition, which enabled them to directly record both preparatory aspects and the course of the defences themselves.

Ethical principles were strictly adhered to throughout the study. All participants were informed about the nature

of the observation, and their participation was voluntary and anonymous. The study was conducted in accordance with the Order of the Ministry of Education and Science of Ukraine No. 422 (2006) and Order of the Ministry of Education and Science of Ukraine No. 947 (2025). Academic literature related to research in the field of literary studies and educational methodology was used as part of the theoretical basis. For example, C. Coffin *et al.* (2003) provided an overview of academic writing practices, while O. Isaieva (2005) outlined pedagogical approaches to literary studies at the high school level. The literature was selected based on its relevance, scientific reliability, and publication in peer-reviewed journals or academic institutions. Sources were obtained from Google Scholar, JSTOR, and the digital database of the National Library of Ukraine.

RESULTS AND DISCUSSION

In the modern paradigm of literary education, research activity conducted by high school and university students is viewed not as an optional component but as an essential condition for the development of interpretive, communicative, and critical competencies. Through individual philological projects, knowledge from literary theory, literary history, poetics, hermeneutics, and stylistics is integrated, while skills in analysing literary texts and producing scholarly expression are simultaneously developed. Research in literary education, both at school and university levels, shares a common goal: to cultivate a creative, critically thinking, and engaged reader and emerging scholar. At the same time, an evolution in research competence is observable – from intuitive interpretation to analytical argumentation. The implementation of a competency-based education model has led to a rethinking of the goals and methods of literary studies. At the core of the educational process lies the development of integrated skills: the ability to independently analyse a literary work, construct an interpretive model, and substantiate conclusions. These skills are most effectively developed through research activity.

For high school students, research is often a way to connect personal experience with literary reality. Such works tend to be emotional and fragmentary in their conclusions but reflect a sincere engagement with meaning. They are often descriptive-interpretive in character, with theoretical frameworks playing a secondary, supportive role. In contrast, student research at the university level requires academic rigor, engagement with a broad source base, and citation of authoritative scholarly opinions. Personal interpretation here is complemented by context – literary, cultural, and philosophical. A university paper must demonstrate the student's ability to think scientifically, to model a problem, and to apply contemporary scholarly approaches. Despite the shared methodological foundation of the competency-based approach, the depth of competence realisation differs. For school students, the primary task is to recognise a literary problem; for university students, it is to conceptualise and interpret it through a theoretical lens. The process of producing a research project in the school or university environment requires clear organisation, sequence, and adherence to methodological logic. O. Isaieva (2005) proposed a structured algorithm that encompasses the key stages of research activity – from choosing a topic to the final defence. This approach not only standardises the process but also makes it possible to trace the development of scientific thinking and analytical skills at each stage. The stages of writing scientific student papers are shown in Table 1.

Table 1. Stages of preparing scientific work (research)

No.	Stage	Main tasks/characteristics	Result
1.	Choosing a research topic	Assessing relevance, novelty, and prospects; formulating a specific research question; focusing on the scientific context and availability of sources.	A clearly formulated and substantiated research topic.
2.	Analysis of scientific sources	Collection and review of specialised literature; analysis of existing theoretical approaches; assessment of the contribution of sources to the development of the problem.	Review of literature on the problem; basis for scientific argumentation.
3	Systematisation of selected sources	Classification of sources (by approach, school of thought, chronology, type); identification of gaps in research and scientific discussions.	Structured catalog of sources; identification of theoretical "nodes" of the problem.
4.	Drawing up an initial plan	Developing the structure of the work (introduction, sections, conclusions); establishing logical connections between sections; distributing material according to volume and complexity.	Preliminary plan (conceptual matrix) of the study.
5.	Processing and organising material	In-depth analysis of the text (motifs, images, structures, strategies); interpretive approach; identifying connections between form and content.	Interpretation of artistic text; preparation of material for analysis.
6.	Formulation of a general research hypothesis	Formulation of an assumption that explains the phenomenon under study; ensuring conceptual accuracy, verifiability, and scientific novelty.	A clearly formulated hypothesis, logically derived from the theoretical basis.
7.	Choosing scientific methods and formulating methodology	Determining the methodological basis (structural-semantic analysis, discourse analysis, intertextuality, etc.); justifying the choice of methods.	Clearly defined and justified research methodology.
8.	Practical application of the chosen methodology	Implementation of methods in practical text analysis; interpretation of plot, motifs, narrative time, imagery.	Results of text analysis; demonstration of competence and consistency in reasoning.

Table 1. Continue

No.	Stage	Main tasks/characteristics	Result
9.	Writing the sections of the work	Combining the results into a coherent academic text; adherence to the norms of scientific style (structure, argumentation, citation, clarity).	Draft version of the entire work; balance and integrity of argumentation.
10.	Formatting the work in accordance with requirements	Compliance with formatting standards (length, font, spacing, title page, bibliography, academic integrity statement).	Final version of the work, ready for submission.
11.	Defence of the research	Public presentation of results; demonstration of the ability to clearly state the purpose, methodology, conclusions; answers to questions.	Completed project.

Source: compiled by authors based on O. Isaieva (2005)

Thus, the structure of the research process outlined O. Isaieva represents a universal algorithm that can be adapted to various levels of academic preparation – from a creative school project to a bachelor's or master's thesis. Its value lies in the gradual formation not only of academic writing skills but also of holistic philological thinking. Each stage is logically connected to the previous one, enabling a consistent progression from idea to successful defence. One of the key goals of literary research in secondary school is to develop students' ability to independently study a literary work as an object of philological analysis. This requires not only a genuine interest in the topic, but also a clear understanding of the methodological sequence from the initial idea to the creation of a coherent academic text. The methodology of students' scientific work is described in detail in the works of V.M. Sheiko & N.M. Kushnarenko (2008). The process begins with the selection of a topic that is both personally meaningful to the student and potentially valuable from an academic point of view. At this stage, the role of the research supervisor is particularly important, as the teacher helps to transform the student's intuitive interest into a well-formulated topic with a clearly defined object, subject, and hypothesis. Student research work should follow the structure of an academic text: an introduction with a statement of the problem and justification, a brief but representative review of the literature, a main analytical section with careful reading, and a conclusion supported by a list of references. The problems of structuring scientific work and interpreting academic texts are addressed in detailed articles by C. Coffin *et al.* (2003) and T. Lillis (2008). They are devoted to the issues of structuring scientific work and interpreting academic texts. They define the tasks for the author of the work and the supervisor, in particular, to gradually learn to substantiate arguments, interpret artistic texts, give examples, and make intermediate and general conclusions. Key skills include the ability to generalise observations, integrate quotations, select appropriate illustrations, and maintain a coherent line of reasoning.

One of the greatest difficulties for school students is working with theoretical sources. Due to their lack of experience in searching for and evaluating academic literature, students often rely heavily on their advisor, who plays a vital role in shaping their philological competence. The teacher should provide a basic list of sources, help evaluate their scientific value, and teach students to distinguish between essential concepts and avoid uncritically reproducing other people's ideas. Particular attention should be paid to working with literary dictionaries, encyclopedias, academic collections, and critical articles (including English-language sources, where possible). The advisor should gradually teach the student how to integrate authoritative scientific opinions into their argumentation this is especially important for the analytical part of the work. S. Verba (2023) focused on the ability to creatively apply the latest achievements in science and technology in practical activities, raising issues of regulatory and legal support for students' research work. The advisor serves not only as a source of knowledge but also as a mentor in the development of scientific thinking. The teacher helps students avoid common mistakes – superficiality, inconsistency, excessive emotionality, or simplistic interpretations. At the same time, the consultant should not replace the student's voice with their own, overly edit the text, or impose excessive formalisation. O.P. Mikhno (2008) wrote about the specifics of the student research method, emphasising dealing with "research of the already known", so the supervisor should not exaggerate the research capabilities of students, but also not leave them within the limits of training exercises. Effective cooperation between the student and the advisor is based on dialogue, joint consideration of the problem, and step-by-step completion of the work. The role of the teacher is not only to guide but also to inspire asking questions that encourage reflection, encouraging independent thinking, and developing a research mindset, "without stifling students' creativity".

The diversity of topics presented at the 2025 All-Ukrainian Junior Academy of Sciences Research Competition reflects a high level of literary awareness among students and their readiness to engage with complex social, philosophical, and cultural issues through the lens of literature (Junior Academy of Sciences of Ukraine, n.d.). In the World Literature section, a notable example is the research project by Sofiia Yermakova (Poltava region), dedicated to architectural imagery in Antoine de Saint-Exupéry's philosophical novel "Citadel". The study examines symbols such as the citadel, temple, and house as artistic representations of existential concepts like responsibility, freedom, and identity. The student analyses metaphorical space as a fusion of physical, psychological, and social dimensions. Yana Vyvalnyuk's (Cherkasy region) project, "Artistic and Semantic Interpretation of the Phenomenon of Silence

in the Novel "Kim Ji-young, Born 1982" by Cho Nam-joo", presents a conceptually well-formulated research problem that integrates philological and sociocultural approaches. At its core is the theme of silence as both a literary device and a manifestation of gender trauma. The paper is notable for its contemporary relevance, theoretical depth, and psychological insight.

Mariia Zadorozhna's (Kirovohrad region) project, "Narrative Strategies in John Fowles's Novel the Collector", offers an in-depth analysis of narrative perspective, structural dynamics, and the narrator's role as a vehicle of psychological manipulation. The research demonstrates the student's ability to apply concepts such as "internal focaliser" and "narrative manipulation", reflecting a high level of analytical competence. The posters for the abovementioned projects are available on the official competition website Junior Academy of Sciences of Ukraine (n.d.). O. Isaieva (2023) rightly emphasised that in scientific research papers, it is essential first and foremost to present one's own conclusions rather than simply summarising the works of other scholars (which, unfortunately, often becomes evident only at the stage of defence). Compiling fragmented excerpts from often questionable sources and presenting them as original research is unacceptable. For the practical implementation of these requirements, the competence of school teachers who supervise such research is sometimes insufficient. Whenever possible, it is necessary to involve qualified specialists and researchers in the preparation of these papers. Overall, the analysis of research topics demonstrates a high level of student interest in contemporary methodological approaches and critical strategies, as well as their desire to combine traditional literary analysis tools with innovative perspectives on the text. There is a noticeable deep interest in literary heritage and contemporary artistic phenomena, the ability of young researchers to perceive sociocultural contexts, comprehend psychological issues, and interpret artistic forms through the lens of the latest scientific paradigms (Table 2).

Table 2. Distribution of student research projects by region, subject, and year of completion

№	Region	Subject, topic	Ukrainian literature			Foreign literature		
			2023	2024	2025	2023	2024	2025
	Cherkasy Region	**Total works**	**16**	**18**	**11**	**14**	**18**	**11**
	Kirovohrad Region	**Total works**	**15**	**14**	**13**	**11**	**12**	**8**
	Poltava Region	**Total works**	**18**	**20**	**18**	**11**	**13**	**12**
1.	Cherkasy Region	**Literary and aesthetic**	3	5	5	3	4	3
	Kirovohrad Region		7	6	5	4	4	3
	Poltava Region		6	7	6	4	6	4
2.	Cherkasy Region	**Relationship issues**	1	3	0	1	1	2
	Kirovohrad Region		7	3	4	5	6	3
	Poltava Region		6	5	5	4	4	4
3.	Cherkasy Region	**Personality issues**	4	2	3	2	3	0
	Kirovohrad Region		8	3	4	5	6	3
	Poltava Region		6	4	4	6	5	5
4.	Cherkasy Region	**Social issues**	0	2	0	2	2	1
	Kirovohrad Region		5	2	5	3	3	3
	Poltava Region		7	6	4	5	4	4
5.	Cherkasy Region	**Historical and national issues**	7	5	3	5	6	2
	Kirovohrad Region		5	4	2	2	3	0
	Poltava Region		4	5	4	1	2	1
6.	Cherkasy Region	**Philosophical issues**	1	1	0	1	1	3
	Kirovohrad Region		8	6	5	6	3	1
	Poltava Region		7	7	3	4	5	4
7.	Cherkasy Region	**Comparative works**	2	3	3	1	3	4
	Kirovohrad Region		2	1	1	1	0	0
	Poltava Region		2	2	0	2	3	2

Source: compiled by authors

The research interests of young researchers and their mentors were distributed as follows: in the Ukrainian Literature section for 2023-2025, 50 participants (35% of the total number of works) researched literary and aesthetic issues, in the Foreign Literature section – 37 (32%); relationship issues – Ukrainian Literature – 34 (24%), Foreign Literature – 30 (26%); personal issues – Ukrainian Literature – 38 (27%), Foreign Literature 35 (30%); social issues – Ukrainian Literature – 31 (22%), Foreign Literature – 27 (24%); historical and national issues – Ukrainian Literature – 39 (27%), Foreign Literature – 22 (19%); philosophical topics were raised in 35 projects (25%) in the Ukrainian Literature section and 28 (24%) researchers of foreign literature; 16 young researchers (11%) in the Ukrainian Literature section and 16 (14%) in the Foreign Literature section were interested in comparative studies.

As can see, the field of literary studies was of greatest interest to young researchers from both sections. Philosophical questions, themes of relationships and personality also attracted the attention of MAN listeners. The authors of projects in the Ukrainian Literature section focused more on national and historical issues in their works than the participants in the Foreign Literature section, and researchers of world literature are more interested in comparative analysis of texts than their colleagues from the Ukrainian Literature section. The diverse topics of the projects presented at the regional stage of the competition-defence indicate that the authors of scientific research are trying to comprehend the semantic field of the text at all its levels, to grasp the aesthetic concept of the artist, to understand the essence of the author-reader dialogue, go beyond the boundaries of a work of art, and see its place in a multicultural space. Since the authors of the works are young people aged 14 to 20, it is natural that, due to the peculiarities of age-related psychological development, young scholars are most attracted to topics of human relationships and the spiritual path of the individual. During the years of russia full-scale invasion of Ukraine, young Ukrainians have been particularly interested in national issues, social life, the place of the individual in society, civic position, eternal questions of life and death, borderline situations, and so on.

The preparation of a student research paper at a university in Ukrainian and world literature is a complex and multifaceted process that requires not only academic discipline from the student but also a high level of analytical thinking, critical evaluation of sources, and deep immersion in the contexts of literary works. Unlike school papers, which are usually focused on a descriptive-analytical level and concentrate on revealing a single topic or individual work, university student research should contain theoretical novelty and offer the student's own vision of the problem; they often may be interdisciplinary. Preparing such work begins with choosing a relevant and scientifically significant topic, which can relate to both contemporary literature and classical texts in a modern interpretation. In student work, the topic always goes beyond purely literary analysis and touches on philosophical, cultural, and sociological aspects. An important stage is the formation of the hypothesis and the clear definition of the aim and research objectives. At this level, the student must justify why their research is relevant, what its scientific novelty is, and how the results can be applied in a broader scientific or cultural context. A student paper requires a thorough review of the source base, including not only Ukrainian but also foreign scholarly publications and materials from specialised databases. Unlike school projects, where the methodological apparatus is often limited to general literary techniques, university student research requires the use of complex methods: cognitive poetics, comparative studies, hermeneutics, intermedial studies, psychoanalytic analysis, and more. This allows a deeper exploration of the topic, showing its complexity and connections with other fields of knowledge.

In-depth textual analysis in university student papers should demonstrate the ability to work with literary material, argue, draw original conclusions, and showcase interpretative competence. In the final conclusions, the student must clearly outline their own scientific contribution and define what future research perspectives their work opens. Equally important is the public presentation of research results. The university student must prepare an informative presentation, often with multimedia support, confidently defend their ideas before a panel, and respond to questions from opponents. This format develops skills of scientific communication, critical dialogue, and the ability to popularise the results of their own work. Analysing student research papers proposed the following topics for student research in Ukrainian literature at institutions of higher education:

- deconstruction of the mother archetype in the novels by contemporary Ukrainian women writers;
- poetics of post-traumatic experience in the poetry of Lina Kostenko and Serhiy Zhadan;
- the phenomenon of silence as an artistic device in the prose of Valerian Pidmohylny;
- reception of ancient myths in contemporary Ukrainian poetry;
- the concept of "city" in war prose by 21st-century Ukrainian;
- feminist interpretations of the image of Carmen in European and Ukrainian literature;
- poetics of magical realism in the works of Lesya Voronyna.

For world literature, promising topics include: the philosophy of existence in the novels of Albert Camus and Ukrainian Sixtiers writers: a comparative aspect; the metaphor of the labyrinth in the works of Jorge Luis Borges and Umberto Eco; poetics of trauma in Kazuo Ishiguro's novel "Never Let Me Go": an interdisciplinary analysis; the image of women in the novels of Virginia Woolf and Maria Matios: parallels and contrasts; intermediality in the "Harry Potter" series by J.K. Rowling: literature, cinema, and fandom culture.

Trends in contemporary literature determine the choice of topics for student research papers, the relevance of the topics and issues raised in the works, and the novelty of comparative analysis. The focus was placed not only on the written texts but also on their mode of presentation, the nature of interaction with the audience, and the level of academic integrity demonstrated by the participants. Mastering research experience for a modern specialist means developing the abilities that allow one to act not according to ready-made algorithms but, when faced with new conditions, to make non-standard decisions and to predict their consequences. However, to achieve these goals, students must go through a challenging path of creative exploration, according to V. Yankin (2025).

Thus, the student's research paper at a university becomes an important stage in shaping the researcher's professional identity, fostering their critical thinking, ability

to innovate, academic integrity, and the capacity to tackle complex problems in modern conditions. First and foremost, it is the choice of a literary work for analysis. It is important that the text has artistic and aesthetic value; sometimes young researchers choose low-quality works, which diminishes the value of their research. A typical mistake is the absence of a literary analysis component; as noted above, the theoretical part is essential for revealing the value of the work and demonstrating depth of study. Students often submit a writer's biography instead of a scientific discourse, even though neither the aim nor the objectives included the analysis of the author's life path.

A common mistake is the disconnection between the theoretical part and the interpretation of the text; for example, the theoretical section might contain a scientific discourse on the theory of dystopia in literature (study of W. Golding's novel Lord of the Flies), while the analysis of the semantic field of the novel focuses on features of its figurative system. It is important to pay attention to the coherence between the scientific apparatus of the project and the main content of the work; it often happens that the stated objectives are not actually realised in the main part of the study. Furthermore, it is essential that the general conclusions analyse the aims and tasks of the work in the context of their implementation. In the analytical-interpretative section, not only is a deep analysis of the work important, but also the confirmation of one's own ideas with quotations from the text. Sometimes, project authors neglect citation material, which leads to a loss of the work's integrity. It is necessary to emphasise to young researchers the importance of independence and originality in presenting material, avoiding mere summaries and reproducing others' ideas.

The most important stage of research activity is the defence competition itself. It is held in three rounds for school students and in two stages for university students: remote evaluation, poster defence (only for school students), and a scientific conference. Here, both practical and psychological preparation of the participants must be considered. The poster defence involves communication between the student (a Junior Academy of Sciences member) and the jury; the author of the project has three minutes to present their work, explain the scientific apparatus, and showcase the main results of the research. It is important to remember that the speech text should be adapted for oral delivery, taking into account the differences between oral and written language. After the presentation, the participant must answer the jury's questions. It is crucial to note that the jury assesses not only the level of familiarity of the young researcher with their own work but also their emotional state (enthusiasm for the project, a positive mood, or, conversely, fear and uncertainty). When answering questions, the participant must not only defend their position but also remember the ethics of scientific discussion. During the conference, participants are given 7-10 minutes to present their project (ideally, the presentations at the poster defence and the conference should not be identical). It is advisable to prepare a presentation that highlights the "highlights" of the research. The conference also includes answering questions from other participants, and the quality of the questions posed to others is also evaluated. This is usually the most interesting stage of the defence: the audience (other Junior Academy members and students) has the opportunity not only to present their own projects but also to get acquainted with others. To succeed in this stage, one should not only carefully prepare their oral presentation but also attentively listen to other participants, ask accurate and insightful questions that show an understanding of the topic of other studies.

Thus, it should be noted that the difference between university student works and school student works lies not only in their complexity, volume, or academic structure, but also in the conceptual level of topic reflection, deep self-reflection, and the desire to find one's voice in the scientific community. Thanks to the system of school (Junior Academy of Sciences of Ukraine, n.d.) and university student literature competitions, a continuous trajectory of developing research competencies is formed, beginning at school and improving at the university level. This enables the cultivation of a generation of scholars capable of creative thinking, generating original ideas, and influencing the development of modern humanities. The results obtained during the empirical study reveal a number of trends related to the development of a research culture among high school and university students. The combination of competitive research papers by high school and university students was in line with the objective of this study. It should be noted that the issue of research activities in schools and higher education institutions has been addressed in a number of scientific publications. L.P. Alyoshkina & I.M. Novak (2021) justified the use of the latest methods of organising scientific and research activities of higher education seekers, in particular, the use of project technologies, as a promising direction for the development of scientific and research activities of students in higher education institutions at the present stage. O.V. Plakhotnik (2020) addressed the preparatory work for scientific work by involving students in subject or research clubs that involve studying the principles, methods, and techniques of scientific work, focusing on individual stages of scientific activity. E.A. Pineteh (2013) proposed a very appropriate strategy for developing students' scientific and creative skills by integrating academic literacy into disciplinary programs and promoting multimodal teaching and assessment. These strategies are possible with close cooperation between language teachers and specialists in core courses. The effectiveness of vertical interdisciplinary programs for the development of academic writing is described by C. Fazio *et al.* (2021), who conducted long-term research at Polish universities. This study focused on the genre, thematic, and problem-oriented nature of the 2023-2025 writing assignments from different regions of the country,

which allowed to conclude that the selected works left a strong emotional impression or raised socially significant issues such as war, trauma, identity, ethical dilemmas, or gender experience.

The development of creative thinking as an important component of research activity accompanies all stages of scientific research. W. Karunarathne & A. Calma (2024) defined creativity as creative self-expression and creative problem-solving. According to researchers E. Karpova *et al.* (2011), in the process of working on creative research, changes in creativity should be taken into account, and the reasons for individual decline in creativity should be identified if such a trend is observed. S. Pukhno (2013) analysed algorithms of active search and research activities at the problem level that contribute to the intellectual and search growth of students, as well as potentially contribute to the emergence of their desire for scientific creativity. S. Pukhno's conclusions are consistent with the results of this study, in particular, the statement about the transition from theoretical to reflective-professional thinking. It is advisable to create problem-solving clubs for students, which, under the guidance of leading scientists, would study professional problems over a long period of time. A promising area of research into the process of writing scientific competition papers by students is the problem of assessment. I. Izarova *et al.* (2024) suggested moving away from traditional quantitative methods to more meaningful and effective assessment methods, in particular, scientific influence, diversity of methodologies and topics, as well as the importance of inclusiveness and interdisciplinarity. V. Ratnikov & A. Teklyuk (2022) warned against the value neutrality of scientific research, as it counteracts the ethical analysis of scientific knowledge, which in turn opens up meaningful perspectives for considering and solving various social, moral, and other problems related to scientific knowledge in a sociocultural context.

The observations of this study partly coincide with the conclusions presented in the article by V. Yankin (2025), which emphasised that the development of the ability to act in conditions of uncertainty and make non-standard decisions is one of the key results of student participation in scientific research. The author argues that research activity is not just a component of the educational process, but a form of deep participation in the act of cognition that contributes to the development of an individual's style of thinking. This perspective fully correlates with the analysis of student research competition projects made in this work. Another point of convergence is V. Yankin's assertion about the importance of transitioning from actions based on fixed algorithms to actions in non-standard situations. This article supports this thesis and expands it with further clarifications: the key factor in this transition is the gradual increase in the complexity of research tasks – from descriptive and reproductive to interpretative, analytical, and problem-solving. The analysis of the competition entries confirms that participants who go beyond the generalisation of theoretical concepts and instead develop their own model of analysis of literary texts demonstrate a higher level of research readiness, which confirms the conclusion about the need to educate researchers as authors, not just consumers of knowledge.

CONCLUSIONS

Thus, the preparation of scientific literary studies by school students and university students within the framework of defence competitions is an important factor in developing their research and interpretative competence. Special importance is given to academic integrity, the ability to work with primary sources, and high standards of scientific ethics. Defence competitions act as an effective tool for socialisation and the formation of academic culture, encouraging young people to self-education, finding their own scientific voice, and improving their level of scientific communication. The analysis of typical mistakes made by school and university students contributed to the development of recommendations for improving the theoretical and analytical level of the works. An important aspect was also the need for the holistic integration of theoretical and practical components of research, strengthening the argumentative basis, and relying on textual sources.

Overall, the study confirmed the effectiveness of research activity as a tool for forming future scholars capable of critical analysis, creative understanding of literary phenomena, and generating innovative ideas in the humanities. Future scientific searches can focus on the development and testing of specialised training programs and methodological manuals for school and university students, which will promote the development of interpretative competence and scientific argumentation. It is also advisable to conduct comparative studies on the preparation of scientific papers in different regions of Ukraine and abroad, in order to identify universal and local strategies for developing research competencies.

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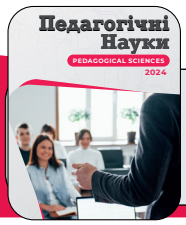
Наукові літературознавчі дослідження старшокласників і студентів: методика конкурсних захистів

Анотація. Актуальність дослідження зумовлена необхідністю розвитку дослідницьких та інтерпретаційних компетенцій у учнів старших класів та вищих навчальних закладів у відповідь на сучасні освітні виклики. Метою цієї статті був комплексний аналіз методології підготовки наукових літературознавчих досліджень у рамках конкурсів-захистів, зосереджуючись на розвитку критичного мислення та здатності самостійно інтерпретувати художні тексти. Були застосовані методи аналізу, синтезу, порівняння, інтерпретації та спостереження. Емпірична складова дослідження базувалася на довгостроковому (3 роки) спостереженні за конкурсами регіонального рівня в Україні, в яких автори брали участь як члени журі. Особливий акцент робився на комунікативному аспекті дослідницької діяльності – як студенти презентують свої висновки, взаємодіють з аудиторією та відповідають на запитання. У статті також розглядалися відмінності між дослідженнями студентського та шкільного рівня, підкреслюючи глибину концептуалізації та міждисциплінарне бачення, необхідне на університетському рівні. Результати аналізу тем та проблем, які найчастіше зустрічаються в наукових роботах студентів середніх та вищих навчальних закладів, виявили певні закономірності у повторюваності у регіонах (Черкаська, Кіровоградська та Полтавська області) та роках написання (2023-2025). Були визначені закономірності у виборі тем та проблем наукових досліджень з української та зарубіжної літератури. Практична цінність статті полягає в наданні рекомендацій щодо покращення якості наукових робіт, формування культури академічної доброчесності, підготовки до публічних виступів та розвитку навичок наукової комунікації. Дослідження сприяє формуванню сталої моделі наставництва літературних досліджень у сучасних освітніх умовах

Ключові слова: інтерпретаційна компетентність; академічна доброчесність; когнітивна поетика; порівняльні дослідження; міждисциплінарний підхід; наукова комунікація



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Experimental study of the development of scientific and research competence of future physical education and sports specialists

Abstract. The relevance of the study lies in the need to develop and implement effective pedagogical conditions and technologies for the formation of scientific and research competence in future specialists in physical culture and sports, which meet modern educational requirements and the real needs of the industry. This work aimed to theoretically substantiate, develop, and experimentally verify pedagogical conditions that ensure the effective development of scientific and research competence in students of the specialty 017 (A7) Physical Culture and Sports. To achieve the goal, theoretical methods (analysis, synthesis, generalisation), empirical methods (questionnaire, observation, pedagogical experiment), as well as methods of statistical data processing were used. The pedagogical experiment was conducted in 2023-2025 on the basis of the Faculty of Physical Education and Sports of the Poltava V.G. Korolenko National Pedagogical University with the participation of 156 applicants for the second (master's) level of higher education. In the control and experimental groups, the dynamics of the levels of formation of scientific and research competence were compared according to the specified criteria. It was established that the formation of scientific and research competence is one of the key conditions for the professional growth of a specialist and their readiness to implement innovations in the field of physical culture and sports. The results of the experimental study showed minor changes in the control group and significant growth in the experimental group: the high level increased from 8 to 31%, the sufficient level from 22 to 43%, while the share of students with average and low levels decreased by 21 and 23%, respectively. Such dynamics are a consequence of the implementation of a set of pedagogical

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conditions: integration of research tasks into the content of academic disciplines, application of project and research technologies, organisation of mentoring support, and reflective and evaluative support. The practical value of the work lies in the possibility of using the proposed approaches in the educational process of training physical culture specialists for the purposeful formation of their scientific and research competence

Keywords: higher education students; professional training; future trainers; pedagogical conditions; project and research technologies; scientific research methodology; innovative technologies

INTRODUCTION

The current stage of development of higher education in Ukraine is characterised by increased attention to the formation of not only professional, but also scientific and research competencies in applicants, which meets the objectives of the European educational space and the requirements of the Concept of Education Development of Ukraine for 2021-2031. In the context of the growing role of science and innovation in the field of physical culture and sports, the ability of future specialists to apply scientific knowledge, analytical thinking, and solve practical problems based on a research approach is gaining particular importance. This approach is the basis of innovative professional thinking, self-development, and improvement of practice in the field of physical education, sports, and health activities. Therefore, to substantiate the key provisions of the study, it is necessary to conduct a detailed analysis of literary sources devoted to the formation of scientific and research competencies.

A. Proskurin & V. Stadnichenko (2023) investigated the features of the formation of scientific and research competence of future coaches as a factor of readiness for effective sports selection. Scientists have proven that the multi-year process of physical education and sports training can be successfully implemented, provided that the age and individual characteristics of human development, the level of their fitness, the specifics of the chosen sport, the features of the development of physical qualities, and the formation of motor skills are carefully taken into account. A modern coach must be a specialist who has scientific and research and prognostic activities, which actualise the formation of scientific and research competence in the system of professional training in higher education institutions.

A. Yefremenko *et al*. (2023) considered research competence as a key component of a coach's professional competence. Scientists noted that it encompasses theoretical knowledge and practical skills necessary to understand scientific research methods in improving the process of training athletes. Among the components of research competence, scientists distinguished analytical skills and self-reflection, which allow the coach to constantly improve. The formation of this competence in future coaches should be based on their motivation for scientific research, which will further contribute to the implementation of modern, scientifically based training methods. V. Stynska *et al*. (2024) emphasised the need to implement special methodological approaches to the development of research skills in students of pedagogical specialties. Since traditional methods often do not give the desired result, there is a need to search for and test new forms and means. This approach should provide not only theoretical understanding but also practical implementation of research projects, which will contribute to the formation of holistic scientific competence. Successfully solving this task is key to preparing competitive specialists capable of innovative activity.

Y. Slodynytska (2025) emphasised the role of an innovative university environment in stimulating the research activity of applicants, which allows them to form a holistic scientific culture. Such an environment contributes not only to the assimilation of theoretical knowledge but also to the development of practical skills necessary for independent scientific research. Involvement in real research projects and interdisciplinary teams creates conditions for the effective formation of scientific and research competence. This, in turn, ensures high-quality professional training and the competitiveness of future specialists in the labour market. Scientists also pay significant attention to the philosophical and interdisciplinary principles of professional training, which directly affect the formation of scientific and research competence, in particular in the studies of Y. Dutczak & V. Antonets (2022), where the competency-based approach is revealed as the conceptual basis of the professional training of a trainer-teacher. The study emphasises that a modern specialist must possess not only theoretical knowledge, but also a set of practical skills necessary to solve professional tasks. The formation of competencies contributes to the adaptation of graduates to the dynamic requirements of the labour market and increases their competitiveness. Thus, the transition from a knowledge-based to a competency-based paradigm is key to the modernisation of higher education in the field of physical education. The monograph by J. McLeskey *et al*. (2022) is a fundamental work for specialists and researchers in the field of inclusive education. The proposed practices are scientifically sound and systematically implemented in the teaching process, which makes them an ideal object for empirical research and provides researchers with a modern methodological basis for the development and validation of educational and corrective programs. The content of the textbook is mainly focused on working with students with mild and moderate disabilities, which allows researchers to focus on effective models of comprehensive training of children. In the study of H. Fastivets *et al.* (2024), philosophical aspects of the formation of professional competence of future teachers, which are important for modern

education, are revealed. The authors analyse the key components of this process, emphasising their interconnection and systematicity. The main attention is paid to determining the philosophical principles that underlie the development of professional qualities of future teachers.

A separate block of research is devoted to the digitalisation of the educational process and the application of information and communication technologies in the development of scientific and research competence. Thus, scientists V. Potop *et al*. (2023) considered digital tools as effective means of optimising research activities in the educational process. Considerable attention is paid to applied aspects of the formation of scientific and research competence in the works of M. Byrka *et al.* (2021). In particular, structural and functional models of the formation of this competence at different levels of education are presented, which allows systematising the training process and ensuring its integrity, taking into account the specifics of each educational level. The implementation of these models contributes to achieving high results in the training of specialists capable of independent scientific work. Scientists P. Čajka *et al*. (2022) proved that universities function not just as educational institutions, but as key drivers of innovation in their region. In addition to teaching students, universities have a mission – to conduct their own scientific research and develop the scientific and research competence of applicants, which generally contributes to the technological, economic, and social development of the region.

Thus, the analysis of scientific sources allows to conclude that the problem of forming scientific and research competence is multifaceted and complex. Scientists justify the need to update the content of education, modernise pedagogical technologies, and integrate scientific activity into professional training, which, in turn, forms a stable basis for the further development of research competencies in future specialists in the field of physical culture and sports. In this regard, it is relevant to develop, implement, and experimentally verify the effectiveness of pedagogical conditions and technologies aimed at developing scientific and research competence of future specialists in physical culture and sports in the process of professional training in a higher education institution. The purpose of the study was the theoretical justification, development, and experimental verification of pedagogical conditions and means that ensure the effective development of scientific and research competence of future specialists in physical culture and sports in the process of their professional training in higher education institutions.

MATERIALS AND METHODS

To achieve the goal and solve the research problems, the study used a set of complementary methods that cover the theoretical, empirical, and statistical levels of analysis. Theoretical methods included the analysis and generalisation of scientific literature devoted to the problems of professional training, the competency approach, and the organisation of scientific and research activities in higher education; systematisation and classification of scientific approaches to the formation of scientific and research competence were carried out, as well as modelling of pedagogical conditions for its purposeful development. The study used a set of empirical methods, in particular: observation, questionnaires, and a pedagogical experiment consisting of ascertaining, formative, and control stages. An important element was the methods of self-assessment and reflection, which allowed for to exploration of the subjective experience of the participants. The applied pedagogical diagnostic methods included questionnaires, testing, analysis of scientific tasks completed by students, expert evaluation, reflective maps, as well as quantitative and qualitative processing of results using mathematical statistics methods (in particular, determining average values, distribution frequencies, and probabilities of differences between groups).

The experimental work was carried out during 2023-2025 at the Faculty of Physical Education and Sports of the Poltava V.G. Korolenko National Pedagogical University. 156 applicants for higher education of the second (master's) level, who studied in the specialty 017 Physical Culture and Sports, were involved in the study. In accordance with the logic of the pedagogical experiment, all participants were divided into control (CG) (n = 78) and experimental (EG) (n = 78) groups of equal number, observing the principle of representativeness; the contingent of students was selected taking into account the same learning conditions, level of training, and motivation for research activities at the initial stage.

Structurally, the experiment had three stages: the ascertaining stage – conducting an initial diagnosis to determine the initial level of formation of scientific and research competence according to the developed criteria and indicators; the formative stage – implementing a system of pedagogical conditions in the experimental group, which took place mainly within the disciplines of the research direction ("Methodology and organisation of scientific research", "Management of scientific and applied projects", "Higher school pedagogy", "Innovative technologies in physical culture and sports"), as well as in extracurricular scientific activities; the control stage – repeated diagnosis to identify changes in the level of formation of scientific and research competence and compare the results of the EG and CG.

The following tools were used to collect data: the questionnaire consisted of 15 closed and open-ended questions. The time to fill out the questionnaire was 15 minutes. The questionnaire contained 20 questions aimed at assessing the scientific and research competence of students. To ensure the reliability of the assessments, the expert consensus method was used, which showed a high level of concordance. To determine the level of theoretical knowledge at the ascertaining and control stages, testing was used, which included questions grouped into four thematic blocks. Each question contained four answer options, which allowed checking the depth and completeness of students' knowledge, for example:

Block 1. Theoretical foundations of scientific research:

1. What is the main purpose of a hypothesis in scientific research?

2. Name the three main stages of the scientific research process.

3. How does a qualitative research method differ from a quantitative one?

4. What ethical principles should be considered when conducting research with the participation of people?

5. Formulate the difference between the object and the subject of research.

Block 2. Planning and organising the study:

1. What steps are needed to formulate a relevant topic for scientific research?

2. Give an example of a specific research goal in the field of physical education and sports.

3. Describe how to select a representative sample for an experiment.

4. What tools will you use to collect data during the observation of the training process?

5. How can you ensure the validity and reliability of the results obtained in the study?

Block 3. Analysis and interpretation of results:

1. What is the meaning of the correlation coefficient, and what does it show?

2. How can you present the obtained results of the study graphically for clarity?

3. Give an example of how to interpret statistically significant differences between two groups.

4. How should the results be summarised to draw conclusions that meet the research objectives?

5. Describe how to prevent erroneous interpretation of data during analysis.

Block 4. Formatting and presenting a scientific paper:

1. What are the main sections that a scientific paper should contain?

2. Describe how to properly format a quote taken from another source.

3. What key elements should be included in the presentation of a scientific paper?

4. How does a reference list differ from a bibliography?

5. What text formatting standards should be considered when writing a thesis?

To assess the validity of the tool, the content validity method was used, which ensures the correspondence of the questionnaire questions to the subject under study. The reliability of the questionnaires was checked using the Cronbach's coefficient of reliability ($\alpha = 0.85$), which indicates high internal consistency. To process the data of the students' testing, the method of mathematical statistics, Student's t-test, was used to compare the mean values in the experimental and control groups. The level of statistical significance was set at $p < 0.05$. The choice of this criterion was due to two main factors: the experimental data had a normal distribution, and the sample size was large enough. Student's t-test was used to compare the statistically significant difference between CG-1 (mean score) and EG-1 (mean score) – to confirm that the groups were the same at the beginning; KG-2 (mean score) and EG-2 (mean score) – to assess whether there is a difference between the groups after the experiment; EG-1 (mean score) and EG-2 (mean score) – to identify whether there were changes in the experimental group after the intervention. Data processing was carried out using SPSS 23.0 software. All research procedures were carried out in compliance with ethical standards. Participants provided informed consent to participate, and confidentiality of their data was ensured. The study complies with the requirements of the American Sociological Association's Code of Ethics (1997).

The experimental group studied under the conditions of implementing the proposed model of the formation of scientific and research competence, which provided for the implementation of a set of pedagogical conditions: integration of research tasks into the content of professionally oriented disciplines; gradual involvement of applicants in individual and group scientific projects; application of project-research technologies; organisation of reflective support of research activities; preparation of teachers for mentoring support. The educational process in the control group was carried out under the conditions of traditional organisation of the educational process without the purposeful formation of scientific and research competence.

To objectively measure the results of the formative experiment and identify the level of development of scientific and research competence of future physical culture and sports specialists, the study defined a system of criteria with indicators that reflect the main components of this integrative quality, in particular: cognitive-content (reflects the level of students' assimilation of theoretical knowledge about the methodology and stages of scientific research), operational-activity (shows the extent to which students have practical skills in conducting research, from formulating a hypothesis to presenting results), motivational-value (assesses students' desire for scientific activity and their awareness of its importance for their future profession), and reflective-evaluative (characterises students' ability to self-analyse and critically reflect on their own research activities). Based on the defined criteria, four levels of scientific and research competence were identified: high (characterised by stable knowledge, formed research skills, pronounced motivation for science, developed reflection and the ability to engage in independent scientific activity), sufficient (implies possession of basic knowledge and skills, the need for partial pedagogical support, a positive attitude towards research activity), medium (manifested in fragmentary knowledge, poorly formed skills, situational or external motivation, superficial reflection) and low (indicates the lack of scientific and research competence: knowledge is random, research actions are unconscious or absent, interest in science is minimal or absent). Such a criterion-level approach allowed to ensure diagnostic accuracy during the ascertaining and control stages of the experiment, as well as to determine the dynamics of changes as a result of the implementation of pedagogical conditions.

RESULTS AND DISCUSSION

In the context of implementing the requirements of the higher education standard in the specialty 017 "Physical Culture and Sports", the formation of scientific and research competence is defined as a key area of professional training. However, the analysis of educational and professional programs of the second (master's) level indicates insufficient systematic inclusion of research components in the content of academic disciplines. The vast majority of courses are focused on the formation of practical, methodological, and organisational skills, while research activities are often considered optional or implemented exclusively during the preparation of qualification work.

The conducted survey revealed a low level of awareness of scientific research methods, limited participation in student scientific activities (circles, conferences, scientific paper competitions), and insufficient motivation to independently study current problems in the field. Only a small part of the respondents demonstrated the ability to formulate scientific hypotheses, determine research methodology, or conduct elementary processing of experimental results. Analysis of the work of teachers indicates a lack of systematic methodological training to support the scientific research activities of applicants, which is due to both the overload of curricula and the lack of incentives for the development of mentoring support in the field of student science. Thus, it was established that there is a contradiction between the requirements for the formation of scientific research competence, declared in educational standards, and the real state of its development in students, which necessitates the purposeful design of pedagogical conditions that would ensure the effective inclusion of students in research activities in the educational process.

The results of the theoretical analysis and the ascertaining stage of the experiment showed the presence of contradictions between the requirements for the formation of scientific and research competence of future specialists in physical culture and sports, declared in regulatory documents (higher education standards, concepts of education development, professional qualification characteristics), and the real level of their development in higher education applicants. In particular, the following were revealed:

- fragmentary inclusion of research elements in the educational process;
- insufficient motivation of students to carry out research activities;
- lack of conditions for the practical application of scientific knowledge;
- low level of formation of analytical, critical, and interpretative thinking;
- limited participation of applicants in collective and individual scientific projects.

Thus, the need to develop and implement a system of pedagogical conditions aimed at activating scientific and research activities is due to both external requests (compliance with state standards, labour market requirements) and internal needs (realisation of students' scientific potential, ensuring continuity of education and self-development). Effective development of scientific and research competence of future specialists in physical culture and sports requires the creation of a holistic system of pedagogical conditions that would ensure the integration of the research approach into all components of the educational process. One of the leading conditions is the integration of scientific and research tasks into the content of professionally oriented disciplines – this involves the inclusion in the curricula of tasks aimed at analysing scientific sources, formulating research hypotheses, developing mini-studies, and testing results in practical activities; such an approach allows combining the assimilation of theoretical material with the practical application of research skills in an industry context.

The next condition is the gradual involvement of students in participation in individual and collective scientific projects – the implementation of this condition occurs through the functioning of student scientific circles, the organisation of participation in professional conferences, scientific paper competitions, the preparation of publications, which forms the experience of research activities, communication skills in the academic environment, and also develops the ability to present the results of their own work (Momot *et al.*, 2025). An important pedagogical condition is the use of project-research teaching technologies aimed at activating the cognitive activity of students; in particular, this involves the use of such methods as educational design, case methods, research workshops, modelling of professional situations; such an approach contributes to the development of critical and analytical thinking, initiative, and the ability to independently solve problems, which is of decisive importance in the training of a new generation of specialists.

Special attention is required for the organisation of reflective and evaluative support for research activities. This involves the introduction of self-assessment and mutual assessment tools, as well as keeping researcher diaries and using reflective questionnaires. This contributes to the formation of students' ability to understand their own research activities, identify difficulties, set goals for further development, and improve personal scientific potential. The fifth pedagogical condition is the preparation of teachers for scientific mentoring and providing the educational process with appropriate methodological support, which involves increasing the level of research competence of teaching staff, developing motivation for mentoring activities, creating instructional and methodological materials, templates for scientific tasks, and feedback forms. Of particular importance is the individualisation of support for students in scientific activities, which allows taking into account their personal interests, pace of development, and level of preparedness. Thus, the identified pedagogical conditions are the basic elements of organisational and pedagogical support for the formation of research competence and form the basis for designing the formative stage of the pedagogical experiment.

In the context of the implementation of certain pedagogical conditions, an important factor in the effective formation of scientific and research competence of future specialists in physical culture and sports is a purposeful rethinking of the content and methodological support of educational disciplines that have a research orientation. In particular, the integration of content, project-analytical, and reflective components into educational courses allows creating a systemic basis for the development of relevant competencies (Teliachyi *et al*., 2023). A key element of such training is the discipline "Methodology and Organisation of Scientific Research", which directly contributes to the implementation of pedagogical conditions related to the integration of scientific and research tasks into the content of professionally oriented disciplines, as well as the organisation of reflective and evaluative support for learning. The course content involves the study of the foundations of scientific knowledge, research methods, and the construction of the logic of empirical and theoretical explorations; The practical part of the training may include the analysis of professional sources, the formulation of hypotheses, the construction of a research structure, the development of mini-research tasks, which ensures that students acquire the skills of independent scientific activity. Additionally, the introduction of such tools as researcher diaries, reflective cards, self- and mutual assessment allows the formation of critical thinking and the ability to objectively analyse one's own activities.

The discipline "Management of Scientific and Applied Projects" is also of great importance, which allows implementing pedagogical conditions associated with the use of project-research technologies and the gradual involvement of students in participation in individual and collective research initiatives. The educational process within this discipline may involve designing full-fledged scientific and applied projects, covering the stages of substantiation of relevance, definition of goals and objectives, selection of methods, formation of expected results, and their public presentation. It is important that students are involved in teamwork, present projects in the educational environment, and receive feedback, which contributes not only to the formation of research but also to communicative competence. In this context, the teacher performs the function of a scientific mentor who accompanies, advises, and corrects research activities, thereby contributing to the development of mentoring in the training system. The discipline "Higher School Pedagogy" has significant potential for training teachers for scientific mentoring and integrating research elements into the process of professional training. Studying the laws of higher education, the principles of organising the educational process, and the specifics of teacher-student interaction allows students not only to master the basics of didactics but also to design their own educational and research trajectory. An important element is the development of pedagogical research methods, in particular in the context of analysing the effectiveness of educational technologies and interpreting the results of the educational process. Thus, students realise the importance of combining the pedagogical and scientific functions of a higher school teacher. A separate functional role in the formation of scientific and research competence is played by the discipline "Innovative Technologies in Physical Culture and Sports", which is focused on the implementation of conditions associated with the use of project-research technologies and involving students in the development and testing of innovative models of professional activity. The course content allows to master the latest digital tools, services for data processing and visualisation, and methods for assessing the effectiveness of innovations in sports practice. Practical classes can be focused on the formation of research groups that work on assessing the implementation of new technologies (for example, GPS tracking, digital monitoring of the athlete's condition, virtual training platforms), with subsequent presentation of the results in the form of reports or scientific presentations.

Thus, the specified disciplines not only allow the realisation of certain pedagogical conditions, but also creating an interdisciplinary basis for the formation of integrative scientific and research competence in students. Their content and organisational transformation in the context of research-oriented training becomes a necessary condition for the preparation of a competitive specialist capable of scientific research, innovative thinking, and professional self-improvement (Popel *et al*., 2023). The results of the control stage of the experiment made it possible to assess the dynamics of changes and the effectiveness of the implemented pedagogical conditions in the process of forming the research competence of future specialists in physical culture and sports (Table 1, Fig. 1).

Table 1. Dynamics of levels of formation of scientific and research competence of future specialists in physical culture and sports

Group	Stage	Level	Percentage (%)	Number of people
CG-1	Before the experiment	High	9	7
		Sufficient	23	18
		Average	40	31
		Low	28	22
CG-2	After the experiment	High	11	8
		Sufficient	25	19
		Average	38	29
		Low	26	20

Table 1. Continue

Group	Stage	Level	Percentage (%)	Number of people
EG-1	Before the experiment	High	8	6
		Sufficient	22	17
		Average	41	32
		Low	29	23
EG-2	After the experiment	High	31	24
		Sufficient	43	34
		Average	20	16
		Low	6	5

Source: developed by the authors

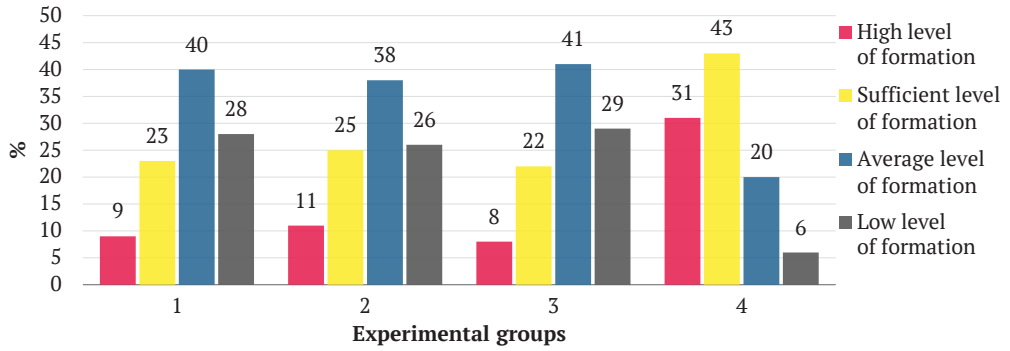

Figure 1. Results of the formation of scientific and research competence of future specialists in physical culture and sports

Note: 1 – control group before the experiment; 2 – control group after the experiment; 3 – experimental group before the experiment; 4 – experimental group after the experiment

Source: developed by the authors

At the beginning of the experiment, no statistically significant differences were found between the control (CG, n = 78) and experimental groups (EG, n = 78) in terms of the level of development of scientific and research competence ($t = 0.42$, $p > 0.05$). The average score in the control group was 21.3 ± 0.7 points, while in the experimental group it was 21.9 ± 0.6 points. This indicates the homogeneity of the groups at the beginning of the study. After conducting the formative experiment, statistically significant changes were recorded in the experimental group. The average score in the EG increased to 29.8 ± 0.5 points, which is significantly higher than in the CG, where the average score was 22.1 ± 0.8 points. According to the results of comparing the averages, the student's t-test showed a statistically significant difference between the groups ($t = 8.11$, $p < 0.05$). These results are confirmed by changes in the percentage distribution of levels: in the EG, the share of students with high and sufficient levels of knowledge after the experiment increased from 30 to 74%; in the CG, this indicator almost did not change, remaining at the level of 36% (CG-1: 32%, CG-2: 36%). Thus, the obtained data prove that the proposed system of pedagogical conditions effectively influenced the development of scientific and research competence in students of the experimental group.

These empirical results correlate with the theoretical foundations of the study, which are based on a multi-component approach to the structure of scientific and research competence. In particular, the study used as a theoretical basis an analysis of publications (Vysochan *et al.*, 2023), which considered the concept of "scientific and research competence" as an integrative characteristic of a person, combining several key components. Cognitive implies the presence of fundamental knowledge of the methodology of scientific knowledge, the foundations of research, as well as mastery of methods of empirical and theoretical analysis. It is this component that forms the theoretical and cognitive basis for understanding scientific principles and their application in professional activities. The operational and activity component reflects the formation of the skills to search, select, and analyse scientific information, plan and implement all stages of research, conduct experiments, and present results in the form of publications. This component is a practical manifestation of the acquired knowledge. Motivational and value – characterised by the student's internal interest in scientific work, the desire for self-realisation through research, and a positive attitude to cognitive activity, which determines the level of his activity and initiative. The reflective component allows a specialist to critically reflect on his experience, identify errors and improve his research approach and includes: critical thinking – the ability to objectively evaluate his own hypotheses, methods and conclusions; the ability to adequately assess

the level of one's competence and identify gaps in knowledge and skills; the ability to adjust one's research goals and plans based on the experience gained. In addition to the main components, it is advisable to supplement this concept with a communicative component, which includes public presentation skills – the ability to speak clearly and convincingly at conferences, seminars, and thesis defence; academic writing – the ability to write scientific articles, theses, and reports, adhering to standards and style; working in research teams, discussing results, and sharing experience with colleagues, etc.

In the works of S. Atamanyuk *et al.* (2021) and I. Boyko's (2025) research competence is not only a sign of high-quality professional education, but also a factor that ensures the ability to self-development, innovative search, and scientific creativity in the field of physical education, sports, and health care. Scientists O. Kornosenko *et al*. (2022) drew the attention of the scientific community to the absence in the educational process of a holistic, purposeful system for the formation of research competence in students, which would involve not only providing relevant knowledge, but also creating an educational environment that stimulates scientific thinking, research activity, and self-realisation of future specialists. The modern education system does not always ensure comprehensive preparation of future specialists for research activities, highlighting the need for the development of new, effective methods and pedagogical conditions aimed at forming both theoretical knowledge and practical skills.

The experience of O. Otravenko *et al.* (2021) on the practical implementation of research approaches in the training of health and sports specialists is also valuable. The authors' works substantiated the importance of developing students' research potential in the context of physical rehabilitation, recreation, and biomedical training. This ensures a close connection between science and practice in the field of physical culture. Such approaches not only help students acquire theoretical knowledge but also provide them with tools to solve real problems. The introduction of research activities into the educational process allows future specialists to acquire the skills necessary for continuous professional improvement, analysis, and assessment of the effectiveness of methods. Ultimately, this contributes to the formation of highly qualified coaches capable of innovation and adaptation to the dynamic requirements of the modern industry.

The effectiveness of the formation of integrative professional competencies (which include scientific and research competencies) is ensured by the implementation of a set of specially developed pedagogical conditions, as evidenced by the scientific studies of M. Kryshtanovych *et al*. (2022) and T. Zhytomyrska (2023). In the context of their research, the conditions act as organisational, pedagogical, didactic, and psychological factors of creating a favourable environment for the development of target personality characteristics. Based on the results of the study, pedagogical conditions were developed aimed at the effective formation of scientific and research competencies of physical culture and sports specialists, which, unlike others, are distinguished by the possibility of operational implementation in practical activities. This means that students can directly test scientific methods during training, physical education, and recreation classes or competitions. Such conditions allow them not only to master the theory but also to immediately observe how it works in real conditions, which makes the learning process more meaningful and motivating. The formation of research competence occurs not as a separate, isolated process, but as part of general training. Students can use research methods to: analyse biomechanical characteristics of movements; assess physiological changes in the body of athletes; compare the effectiveness of different training methods. This integrates research skills into the professional toolkit of the future specialist, making him capable of constant self-improvement and innovation. Also, research in this area requires knowledge not only of pedagogy, but also of related sciences: biology, physiology, biomechanics, psychology, and medicine. Specially selected conditions allow students to simultaneously develop competencies in different scientific fields, creating a holistic understanding of the human body and its capabilities. This approach prepares them to solve complex, complex tasks that arise in professional practice.

Thus, the research competence of a future specialist in physical culture and sports is a holistic system that integrates knowledge, skills, motivation, reflection, and communicative culture. It is necessary for effective professional activity in the conditions of modern education, which is confirmed by research (Kornosenko *et al.,* 2021; Zhytomyrska, 2023). The specificity of the conditions lies in the inextricable link between theoretical knowledge and practical experience. That is why there is a need for the organic integration of research tasks into the content of professional training, which will allow future specialists to apply scientific approaches to solving real problems in the industry. Based on the analysis of the data obtained, it was established that the integration of research approaches into the educational process contributes to the formation of a specialist capable of high-quality and competitive thinking. Thus, research competence is not only an element of professional competence, but also a key factor in the high-quality training of a specialist in the field of physical culture and sports.

The results of the pedagogical experiment confirmed the effectiveness of the proposed system of pedagogical conditions, ensuring a statistically significant increase in the level of scientific and research competence in the experimental group compared to the control group. In particular, in the experimental group, the number of students with a high level of research competence formation increased more than threefold (from 8 to 31%), and the share of those who reached a sufficient level doubled (from 22 to 43%). At the same time, in the same group, there was a sharp decrease in the number of students with low and

medium levels of competence. The number of students with an average level decreased more than twice (from 41 to 20%), and with a low level, almost fivefold (from 29 to 6%). These positive changes in the experimental group are directly related to the implementation of a set of pedagogical conditions focused on the formation of research activity of applicants: in particular, the inclusion of research-related tasks in the educational process (within the disciplines "Methodology and Organisation of Scientific Research", "Innovative Technologies in Physical Culture and Sports") contributed to the growth of the cognitive-content and operational-activity components of competence; applicants learned to formulate scientific problems, hypotheses, choose research methods, work with the source database, conduct experiments, formalise results and present them. An important role was played by the gradual involvement of students in individual and collective scientific projects that were implemented within the discipline "Management of Scientific and Applied Projects" and in extracurricular work; such activities allowed the participants of the experimental group to gain experience in team interaction, scientific communication, and responsibility for the result. In addition, the organisation of reflective and evaluative support for research activities contributed to an increase in the level of awareness and self-assessment of students of their actions; the use of researcher diaries, reflection questionnaires, and self-assessment forms allowed to strengthen the reflective and evaluative component of competence; active mentoring by teachers, methodically prepared for mentoring activities (especially within the discipline "Higher School Pedagogy"), became an additional factor of success. The implementation of the communicative component allowed the improvement of research activity through the formation of skills of clear and reasoned presentation of thoughts during presentations. Students also gained experience in scientific communication at conferences and seminars, which helped to establish professional contacts and exchange experiences. In addition, joint work on projects developed the skills of effective team interaction, which is critically important for future professional activities. Thus, the formation of scientific and research competence requires the efforts of both sides of the educational process – the teacher and the applicant – and is based on a shared awareness of the value of research as a resource for professional development and a tool for innovative renewal of the sphere of physical culture and sports.

It is important for teachers to ensure the organic implementation of research tasks in the educational process. This involves updating the content of professionally oriented disciplines and supplementing them with tasks of an analytical, problem-based, and empirical nature. The practice of the experimental group confirmed that the use of project-research teaching technologies (in particular, methods of case analysis, design, and modelling of real situations) contributes not only to the activation of students' cognitive activity but also to the formation of their ability to independently solve professionally significant tasks. In addition, the development of the teacher's mentoring function is of particular importance. Providing scientific support, providing advisory support, motivating students to participate in scientific circles, conferences, and competitions, and contributing to the formation of a scientific culture and a sustainable interest in research activities. It is also worth paying attention to the development of the reflective component through the introduction of such tools as researcher diaries, reflective questionnaires, and individual maps of research growth.

It is important for higher education students to actively engage in research activities from the first stages of professional training. Particular attention should be paid to the development of critical analysis skills, working with scientific sources, and forming their own research interest. The study showed that students who systematically participate in scientific activities demonstrate a higher level of competence formation, readiness for independent knowledge, and professional self-improvement. An important factor is the formation of the ability to reflect and self-assess their own activities, which ensures awareness of personal progress, setting new goals, and orientation to results. It is advisable for students to use elements of self-organisation, in particular, maintaining an individual portfolio, analysing the dynamics of their own research experience, and processing constructive feedback from teachers and colleagues.

CONCLUSIONS

It was determined that scientific and research competence is an integrative characteristic of the personality of a higher education applicant, which involves the formation of knowledge in the methodology of scientific knowledge, the ability to carry out research activities, positive motivation for scientific activity, reflexivity, and readiness for self-development. Its development in students of the specialty 017 Physical Culture and Sports should be based on targeted influence through the content of professional training, organisational and pedagogical conditions, and mentoring support. A system of pedagogical conditions has been proposed and implemented, which includes: integration of research tasks into the content of professionally oriented disciplines; gradual involvement of students in individual and group scientific projects; application of project and research technologies of education; organisation of reflexive and evaluative support; preparation of teachers for mentoring activities.

Results of a formative experiment conducted at the Faculty of Physical Education and Sports of the. Poltava V.G. Korolenko National Pedagogical University, during 2023-2025, with the participation of 156 applicants for higher education of the second (master's) level, confirmed the effectiveness of the implemented model. In the control group, the indicators of the levels of formation of research competence remained almost unchanged, while in the experimental group, a significant increase in the proportion of students with high and sufficient levels was recorded (the total increase was over 40%), which was accompanied

by a decrease in the number of applicants with medium and low levels. The generalisation of the results allows to state that the effective formation of research competence in the system of training future specialists in physical culture and sports is possible under the condition of comprehensive implementation of pedagogical conditions, adaptation of the content of academic disciplines, development of research motivation, mentoring support from the teacher, and creation of a reflective educational environment. The conducted study laid a scientific and methodological foundation for the purposeful formation of research competence of future specialists in physical culture and sports. An important problem for further scientific development is the creation and testing of adaptive models of individualisation of research training for students with different levels of academic success and motivation.

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CONFLICT OF INTEREST

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Експериментальне дослідження розвитку науково-дослідницької компетентності майбутніх фахівців фізичної культури і спорту

Анотація. Актуальність дослідження зумовлена необхідністю розроблення та впровадження ефективних педагогічних умов і технологій для формування науково-дослідницької компетентності у майбутніх фахівців фізичної культури і спорту, що відповідає сучасним вимогам освіти та реальним потребам галузі. Метою роботи було теоретично обґрунтувати, розробити та експериментально перевірити педагогічні умови, які забезпечують ефективний розвиток науково-дослідницької компетентності студентів спеціальності 017 (А7) Фізична культура і спорт. Для досягнення мети використано теоретичні методи (аналіз, синтез, узагальнення), емпіричні методи (анкетування, спостереження, педагогічний експеримент), а також методи статистичної обробки даних. Педагогічний експеримент проведено у 2023-2025 роках на базі факультету фізичного виховання та спорту Полтавського національного педагогічного університету імені В. Г. Короленка за участі 156 здобувачів другого (магістерського) рівня вищої освіти. У контрольній і експериментальній групах здійснено порівняння динаміки рівнів сформованості науково-дослідницької компетентності за визначеними критеріями. Установлено, що сформованість науково-дослідницької компетентності є однією з ключових умов професійного зростання фахівця та його готовності до впровадження інновацій у сфері фізичної культури і спорту. Результати експериментального дослідження показали незначні зміни в контрольній групі та суттєве зростання у експериментальній: високий рівень зріс із 8 до 31 %, достатній – із 22 до 43 %, водночас частка студентів із середнім і низьким рівнями зменшилася на 21 та 23 відсоткові пункти відповідно. Така динаміка є наслідком реалізації комплексу педагогічних умов: інтеграції дослідницьких завдань у зміст навчальних дисциплін, застосування проєктно-дослідницьких технологій, організації наставницької підтримки та рефлексивно-оцінювального супроводу. Практична цінність роботи полягає у можливості використання запропонованих підходів в освітньому процесі підготовки фахівців фізичної культури для цілеспрямованого формування їхньої науково-дослідницької компетентності

Ключові слова: здобувачі вищої освіти; професійна підготовка; майбутні тренери; педагогічні умови; проєктно-дослідницькі технології; методологія наукових досліджень; інноваційні технології

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Education as an instrument of ideology: The teaching of history in Bulgarian schools during socialism (1944-1989) and nowadays

Abstract. Research into the instrumentalisation of historical education for the ideological legitimisation of power remains relevant both for understanding the mechanisms of socialist regimes and for analysing the contradictory processes of post-socialist transformation. The aim of the study was to reveal the evolution of mechanisms of state control over historical education in Bulgaria through a comparative analysis of the instruments of direct indoctrination during the socialist period (1944-1989) and hidden forms of ideologisation in the present day. The methodology was based on a problem-chronological approach, combining an analysis of institutional changes in Bulgarian education policy and regulatory acts with a study of the transformation of historical narratives and educational programmes in both periods. The results of the study showed that during the period 1944-1989, a total system of ideological control was formed in Bulgaria, based on the institutional subordination of science to the Bulgarian Academy of Sciences, censorship restrictions by Glavlit, and the normative establishment of Marxism-Leninism as the only methodology. It has been established that through the implementation of the 1959 Law on the Connection of School with Life, historical education was integrated with industrial practice, becoming an instrument for fostering loyalty through labour, and the narrative was focused on the "founding myth" of 9 September 1944 and class struggle. It has been demonstrated that after 1989, there was not a de-ideologisation, but a "narrative inversion", in which the socialist canon was replaced by the rhetoric of totalitarianism to legitimise market reforms. The analysis revealed a transformation of direct pressure into "soft" control mechanisms – the structural displacement of the topic of socialism to the end of the 12th grade curriculum, a focus on standardised exams that require memorisation of facts rather than analysis, and systematic disregard for personal sources and the traumatic experiences of ethnic minorities (particularly during the "Revival Process"), which blocks the formation of critical reflection on the past. The practical significance of the study lies in presenting a model for analysing the long-term ideological influence on education and providing tools for identifying "hidden" mechanisms of instrumentalisation

Keywords: totalitarianism; historiography; indoctrination; communism; society

INTRODUCTION

School history education serves as a mechanism for shaping collective memory and national identity. In states that have undergone periods of ideologically driven governance, such as the countries of the former Eastern Bloc or the Union of Soviet Socialist Republics (USSR), the analysis of past educational practices and their long-term legacy is of particular scholarly interest for understanding the relationship between political regimes and public consciousness. For Bulgaria during the socialist period (1944-1989) and the subsequent decades of transformation, the relationship between state ideology and the teaching of history has been a central subject of academic inquiry. Understanding the processes through which historical narratives were constructed in that era, as well as examining the legacy of these processes in the present, has shaped the relevance of this study.

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B. Magyar & B. Madlovics (2020) proposed expanded conceptual frameworks for understanding the functioning of post-communist regimes by systematising their political and economic characteristics. The researchers moved beyond standard models of transition, arguing for the need to analyse the specific anatomy of regimes that emerged from the ruins of socialism and their propensity for authoritarian relapse. This macro-analysis is complemented by studies focusing on concrete instruments of ideology. I. Znepolski (2020) analysed the interaction between communist doctrine and the academic sphere, proposing a theory of the detotalitarianisation of science. The author examined in detail the mechanisms through which party control penetrated scientific institutions, as well as the difficulties involved in freeing academic knowledge from ideological layers in the post-Soviet period. Other scholars, such as D. Genova (2022), concentrated on the linguistic mechanisms of propaganda, showing how party slogans ritualised social life. In her work, the author demonstrated that the language of posters and official speeches served as an instrument for creating a pseudo-reality that substituted reality with ideological constructs. In the Bulgarian context, these control mechanisms also extended to extracurricular activities.

Y. Yancheva (2022) analysed in detail the role of the Pioneer organisation as an instrument for the disciplining of the individual, which operated parallel to the school system to foster loyalty. The study showed that through a system of rituals and collective responsibility, the state sought to establish control over the free time and private lives of young people. The fall of the Communist regime in 1989 initiated new challenges, which were also reflected in academic works. B. Koulov (2024) identified the structural and financial problems faced by Bulgarian education in the post-socialist period, stressing that demographic decline and chronic underfunding became major obstacles to effective modernisation. Alongside administrative reforms, a struggle over historical memory emerged. G. Medarov & V. Stoyanova (2024) examined competing representations of totalitarianism in contemporary Bulgarian historiography, revealing the impact of current politics on interpretations of the past. The author argued that historical narratives often become hostages of political battles, where the past is used to discredit opponents. The problems of forming education about the Communist period were analysed in detail by E. Kelbecheva (2020), who revealed the difficulties in overcoming contradictory narratives and the instrumentalisation of memory. The researcher emphasised the necessity of creating new methodological approaches that would allow pupils to critically reflect on the complex pages of history without simplifications.

At the centre of these transformations stood history education itself. V. Uzunova (2023) conducted a comprehensive analysis of reforms in the teaching of history in Bulgaria, comparing the key stages of change between 1948 and 2002 and tracing the direct influence of politics on methodology. The work demonstrates the cyclical nature of the reforms, which often depended on changes in governments and foreign policy vectors. At the same time, I. Garai *et al*. (2025) proposed considering educational reforms as a separate pedagogical phenomenon. The authors demonstrate how the historical context affects the implementation of modern initiatives, emphasising the importance of taking local traditions into account when implementing international standards.

Existing studies on education in Bulgaria, as outlined above, have tended to document the presence of ideological control or analyse the challenges of the post-socialist period. However, they have lacked a comprehensive comparative examination of how specific historical narratives evolved in school textbooks between 1944 and 1989, as well as a detailed comparison of socialist-era mechanisms of ideological shaping with the new, "hidden" forms of instrumentalisation that emerged after 1989. As a result, a gap remained in understanding whether genuine de-ideologisation occurred, or whether ideological instrumentalism merely shifted from an overt to a more concealed form.

The aim of this study was a comparative analysis of the mechanisms of ideological shaping within history education in Bulgaria during the socialist period (1944-1989) and to identify how these approaches transformed into hidden forms of instrumentalisation in the post-socialist era. To achieve this aim, the following objectives were set: to identify the key stages and mechanisms (institutional, methodological, and censorial) of party control over the content of history education between 1944 and 1989; to analyse, using normative documents and curricula, the evolution of representations of central themes in Bulgarian history; and to explore the main trends in the transformation of historical narratives in Bulgaria after 1989, revealing the new concealed mechanisms of ideological influence, including those embedded in curriculum structuring and testing practices.

MATERIALS AND METHODS

The study was based on an analysis of published sources covering the period from 1944 to 2025, which made it possible to carry out a comparative examination of the two eras under consideration – the socialist period (1944-1989) and the post-socialist period (after 1989). The selection of materials was guided by their relevance to the study of state ideology in Bulgaria, educational policies, and historical memory. The inclusion criteria comprised four main types of sources: fundamental doctrinal texts of Marxism-Leninism, official party historiographical works from the socialist era, contemporary academic studies on educational transformations, and personal sources that document cultural memory and everyday experience. A separate group of sources consisted of legal and regulatory acts: the Law of Bulgaria No. 218 "On National Education" (1948) and the latest update of the Law of Bulgaria No. 112-27 "On Higher Education" (1955). Their comparative analysis made it possible to trace the transformation of legislative priorities from the ideological control of early socialism to nowadays European standards of academic autonomy. The exclusion criteria allowed the removal of works on general pedagogy

that were not directly related to the teaching of history, as well as historiographical works that were unrelated to the Bulgarian context or to the chronological periods studied.

To understand the methodological foundations that were forcibly imposed on Bulgarian scholarship and education, the study drew on fundamental texts of Marxism-Leninism, including F. Engels' (1999) work on historical materialism, which explains the doctrine of the five formations. This foundation was supplemented with selected works by key ideologists of Bulgarian communism, such as T. Zhivkov (1975) and G. Dimitrov (2022), which demonstrated how this doctrine was adapted and applied in concrete political practice. To analyse the officially sanctioned "grand narrative", party publications were used, exemplified by The History of the Bulgarian Communist Party (Vekov *et al.*, 1980). For the study of the post-socialist period, research analysing educational reforms and their outcomes was included. To understand the context of everyday life, which is often excluded from official narratives, projects dedicated to cultural memory were used, recording experiences "from below" (Genova & Gospodinov, 2006).

The problem-oriented chronological method served as the basis for structuring the entire study. It made it possible to divide the analysis into two stages – "The Institutionalisation of Ideological Control (1944-1989)" and "Reforms and Narrative Transformations (after 1989)". The use of this method enabled not merely a chronological description of events, but the tracing of the evolution of specific issues – mechanisms of control and the content of narratives – over time.

Institutional analysis was applied to examine the formal and informal structures through which ideological control was exercised. This method made it possible to focus on the mechanisms shaping educational content. For the period 1944-1989, it helped identify the roles of the Bulgarian Academy of Sciences, Glavlit as the censorship authority (Znepolski, 2020), and party committees as departments of agitation (Sygkelos, 2011). Applying this method to the post-socialist period made it possible to reveal new mechanisms of influence, such as the institutional design of curricula and the pressure exerted by standardised testing. Comparative-historical analysis became a central tool for demonstrating "narrative inversion" and was used to directly compare interpretations of key events and terminology in the two periods.

Narrative analysis was used to deconstruct the language and logic underlying the construction of historical narratives in textbooks and academic works. This method helped reveal not only what was said, but how it was said, as well as what was omitted. Narrative analysis made it possible to identify the tendency towards the "personalisation" of the socialist past around the figure of T. Zhivkov. In addition, the method revealed a key form of systemic exclusion in contemporary textbooks – the marginalisation of "history from below", including everyday experience and the history of repressed minorities (Pomaks, Turks), in favour of dominant "state" sources presented "from above".

RESULTS

Institutionalisation of ideological control over historical scholarship (1944-1989)

The establishment of a new political regime in Bulgaria after 9 September 1944 led to a fundamental restructuring of the humanities. Historical scholarship was designated as a key instrument for the ideological legitimisation of power and for the conduct of the "class struggle". Between 1948 and 1952, an extensive system of party-state control over the production of historical knowledge was created and institutionalised (Békés, 2022). This process encompassed all levels, from the reorganisation of major research centres and the normative entrenchment of a single methodology to the introduction of total censorship and direct party supervision of historiographical projects. The purpose of these measures was to transform history from an academic discipline into a service mechanism that met the ideological needs of the regime.

One of the first steps in subordinating historical scholarship was its institutional reorganisation. Prior to 1944, Sofia University had retained its status as the country's principal academic centre, with long-standing traditions of relative autonomy. The new authorities took steps to alter this balance, and as early as November-December 1944 a provisional leadership of the Bulgarian Academy of Sciences was appointed. This process continued, and in 1947 a separate Institute of Bulgarian History was established within the structure of the Bulgarian Academy of Sciences. This institutional reform was not merely an administrative change but a deliberate act aimed at centralising scholarly research under party-state control. The creation of a history institute within the Bulgarian Academy of Sciences rather than within the university enabled the Bulgarian Communist Party to establish direct administrative and ideological control over the research process. This was achieved, among other means, through the appointment of ideologically loyal and vetted personnel to key leadership positions within the Academy and its newly created institutes. As a result, the Bulgarian Academy of Sciences was transformed from an academic learned society into the principal instrument for implementing state policy in science. Historical research was effectively removed from the sphere of university autonomy and incorporated into the vertical structure of the party-state apparatus, which significantly facilitated the subsequent imposition of uniform methodological and ideological standards (Szumski, 2019).

Institutional control alone, however, was insufficient to ensure the complete subordination of the discipline. The regime also required the unification of the methodological foundations of historical scholarship. This function was fulfilled by the First National Conference of Historians, held in 1948. This event, alongside other initiatives such as the Second Congress of the Fatherland Front in February 1948, served to formally entrench the new ideological framework. The conference effectively established Marxism-Leninism as the sole permitted and mandatory methodology for all historical research in Bulgaria.

Historical materialism was proclaimed as the central doctrine (Sygkelos, 2011). This theory, as formulated by F. Engels, interpreted the course of history as a process driven by a "final cause and great driving force" rooted in the economic development of society, in changes in modes of production and exchange, and consequently in the division of society into classes and the struggle between them (Engels, 1999). The introduction of this dogma into Bulgarian historiography after 1944 meant that the historical process was henceforth to be interpreted exclusively through the prism of class struggle. The 1948 conference officially declared all previous, non-Marxist historiographical approaches to be "bourgeois", "reactionary", and unscientific. This decision had far-reaching consequences, as it enabled the formal and coercive fusion of historical scholarship with the dominant ideology. History lost its explanatory function and was reduced to an illustrative one; its task was no longer to investigate the past, but to provide "historical" evidence and illustrations for pre-determined ideological theses concerning the inevitability of the victory of socialism and the vanguard role of the Communist Party (Békés, 2022).

The formation of a new ideological canon required a dual strategy that involved not only the active promotion of Marxist narratives but also the aggressive elimination or concealment of any alternative views and facts. A key role in this process was played by a specially created censorship institution. Following the Soviet model, the Main Directorate for Literature and Publishing (Glavlit) was established in Bulgaria. This body exercised total control over all printed materials, from newspapers to scholarly monographs. Libraries, which in the conditions of the 1940s and 1950s – when television was rare and newspapers were under full party control – served as the main source of information for a large segment of society, were rapidly transformed by the new regime into "an instrument in the hands of the communist state". Their new task was no longer merely to provide access to knowledge, but to "actively impose a new socialist way of thinking". Glavlit and the libraries under its supervision not only prohibited publications but also constructed a new informational reality. They restricted readers' access to "harmful" literature by creating "boundaries to access scientific information". Books that contradicted the party line, represented non-Marxist perspectives, or belonged to "bourgeois" historiography were removed from open collections. Following the Soviet example, so-called special collections were created for such works. These were restricted repositories to which access was tightly controlled and granted only to a narrow circle of vetted individuals – primarily nomenklatura officials or ideologically reliable scholars – on the basis of special permission. In this way, Glavlit and the special collections were not merely instruments of repression against books; they were tools for constructing a new ideological canon through the creation of a fully controlled informational space (Roberts, 2022).

Alongside censorship, which performed a "negative" function of purification, the regime actively pursued a "positive" function – the production of its own texts. An example of this approach was the multi-volume project History of Bulgaria, the first two volumes of which were published in 1954-1955, as well as the publication of the History of the Bulgarian Communist Party (Vekov *et al.*, 1980), which consolidated the official party version of events. This project was not the result of independent academic initiative or scholarly debate; it was a direct party commission implemented under close supervision. The process of writing and publication was controlled not only at the national level. The project also had a foreign-policy dimension and was carried out under the academic patronage of the Institute of Slavic Studies of the Academy of Sciences of the USSR (Szumski, 2019). The production of such synthesising works reflected a shared objective: not the creation of unique national histories, but their integration into a common Soviet narrative. This narrative was intended to emphasise the "leading role" of Russia, and later the Soviet Union, in the history of the Slavic peoples, based on the doctrinal theses of G. Dimitrov (2022) concerning the decisive importance of Soviet assistance and the "unbreakable friendship" with the USSR as a guarantee of national sovereignty. Historians involved in such projects received specific instructions, and the process was supervised directly by the Central Committee of the party. Any contacts or visits by Soviet historians to countries of the Eastern Bloc were sanctioned by the Central Committee of the Communist Party of the Soviet Union, and reports were submitted both to the Presidium of the Academy of Sciences and to the Central Committee. This transformed historiography into a service discipline that was required to respond to current political needs. When the Politburo of the Bulgarian Communist Party adopted particular decisions, or when the country's leader T. Zhivkov (1975) adopted a hard-line stance on international issues and justified the party line in his speeches, historians were expected to provide immediate ideological substantiation. A clear example is the reaction to the events of the "Prague Spring" in 1968. T. Zhivkov was among the first to define the events in Czechoslovakia as a "counter-revolution". In response, Bulgarian media and the ideological apparatus immediately intensified narratives about "bourgeois ideology", "anti-communism", and the "ideological subversion of imperialism" (Szumski, 2019).

The institutional and methodological control established over historical scholarship found its logical culmination and practical realisation within the system of school education. While academic institutions (such as the Bulgarian Academy of Sciences) and censorship bodies (such as Glavlit) were responsible for producing and filtering the "grand narrative", the task of the school was its didacticisation. The school was intended to transmit the approved ideological canon, to embed it in the consciousness of new generations, and, crucially, to embed it not only at the cognitive level but also at the emotional level through a system of everyday practices, extracurricular activities, and social rituals (Vukov, 2008).

The Bulgarian Communist Party consciously modelled its policies in all spheres, including education, on the example of the Soviet Union. This process unfolded against the backdrop of broader social transformation, as Bulgaria was transformed during the 1950s-1970s from a predominantly agrarian society into an industrialised socialist state. Education was viewed as a key element of this process, aimed at "raising the educational level of the population" and cultivating a "new person" within the framework of the dominant ideology (Dragostinova, 2022). The Sovietisation of education meant not only copying administrative structures but also a complete restructuring of the legislative basis following the Soviet model. It involved the direct adaptation of curriculum content, which was first systematically established in the Law of Bulgaria No. 218 "On National Education" (1948). Bulgarian history was rewritten and structured in accordance with the Marxist-Leninist dogma of the five socio-economic formations, which directly followed the doctrine of historical mercantilism approved as the sole methodology in 1948 (Table 1). This unification had a specific goal: the Bulgarian pupil was to study history not as a unique national process, but as a local example of the universal and inevitable laws of the class struggle. The history of Bulgaria, thus, was merely intended to confirm the correctness and universality of the Soviet model of development, which inevitably led to Socialism and Communism.

Table 1. The Marxist-Leninist doctrine of the five formations and its application in Bulgarian historiography

Socio-economic formation	Key characteristics (according to the doctrine of historical materialism)	Application to Bulgarian history (in official historiography, 1944-1989)
Primitive communal system	Classless society, communal ownership of primitive means of production, absence of exploitation	Ancient history of the Bulgarian lands (Thracians, Slavs, Proto-Bulgarians) prior to the emergence of state formations
Slave-owning system	The first class-based antagonistic society, with the main classes being slave owners and slaves; private ownership of the means of production and of the slaves themselves	The ancient period in the Balkans (e.g., Greek colonies, the Roman Empire). This stage was often debated in terms of how clearly it applied to the Thracians
Feudal system	The main classes are feudal lords (landowners) and dependent peasants; the primary means of production is land; serfdom or other forms of extra-economic coercion	The First and Second Bulgarian Empires. The period of Ottoman rule was defined as "Ottoman feudalism", and the national liberation struggle as "anti-feudal"
Capitalist system	The main classes are the bourgeoisie (owners of capital) and the proletariat (wage labourers); private ownership of the means of production; exploitation of wage labour	The period from Liberation in 1878 to 1944. Described as a stage of "the emergence and development of capitalism", culminating in a "monarcho-fascist dictatorship"
Socialism/ Communism	Socialism – the first, transitional phase. Public ownership of the means of production, the dictatorship of the proletariat (rule of the Communist Party), a planned economy. Communism – the higher, classless phase, based on the principle "From each according to ability, to each according to need"	The period after 9 September 1944. Officially proclaimed as "the construction of socialism" and the inevitable, scientifically grounded transition to communism

Source: compiled by the author based on A. Vekov *et al*. (1980), F. Engels (1999)

The analysis of the table demonstrated the determinism of the historical narrative that was implemented in Bulgarian education. As is evident from the table, each stage of Bulgarian history was coercively assigned a corresponding formational label, which sometimes contradicted historical realities (particularly regarding the slave-owning system or the specific nature of the Ottoman period). Such a structure left no room for alternative interpretations; the entire historical path of the nation was presented as a linear movement from exploitation to Communism, with 1944 becoming the culminating point of this development.

A central element of the new school canon became the regime's "foundational myth" – the events of 9 September 1944. This myth was essential for legitimising the power of the Bulgarian Communist Party. As acknowledged in post-communist historiographical debates, the regime was established through a military coup, the success of which was possible only due to the direct intervention of the Soviet army on 8 September 1944 (Naimark, 2017). However, within the official socialist narrative this event was completely transformed and presented as the culmination of a broad "anti-fascist resistance" and a "popular armed uprising". Accordingly, academic priorities and the content of history textbooks for grades 8-11 were focused precisely on the "partisan movement", the "anti-fascist struggle", and "class warfare". History was radically simplified and structured through binary oppositions. The entire historical process was reduced to a confrontation between "progressive" forces (the proletariat, partisans, the Bulgarian Communist Party) and "reactionary" ones (the bourgeoisie, "monarcho-fascists"). This binarity eliminated ambiguity, nuance, and complexity, rendering the historical process simple and easily digestible for ideological internalisation. This ideological canon also had a direct social embodiment that extended beyond textbooks, notably through university admission quotas. A special category of "active fighters against fascism and capitalism" was created; these individuals and their children were granted social privileges, among the most important of which was guaranteed access to higher education outside the general competitive admissions process, formalised through specific regulations. Thus, the educational system did not merely promote the

myth of the "anti-fascist resistance" in history lessons. It actively participated in the creation and reproduction of a new, regime-loyal social aristocracy whose privileged status was directly tied to this ideological narrative (Wcislik & Kopeček, 2015).

Ideological influence was not confined to the forty-five minutes of the history lesson; it extended into the extracurricular sphere, aiming at the emotional (affective) consolidation of the cognitive knowledge acquired in class. The objective was to create a total ideological environment in which pupils would constantly remain within the field of influence of party narratives. Numerous thematic exhibitions were organised, not only in museums but also in factories and institutions. These exhibitions were dedicated to the "heroic" past canonised by the party and bore titles such as "Behind the Bars of Fascist Prisons", "Partisan Everyday Life", or "Paratroopers and Submariners". Schools introduced compulsory extracurricular activities with a militaristic and ideological character. From 1976 onwards, military clubs were established as after-school activities. Even earlier, from the autumn of 1968, compulsory two-year military training was introduced for all boys and girls aged 16 to 18. A deliberate synchronisation of three calendars took place: the pedagogical calendar (school year, holidays), the historical calendar (anniversaries of the "resistance", birthdays of "heroes", battle commemorations), and the political calendar (party congresses, state holidays). School assemblies, "lessons in courage", and compulsory meetings with "veterans" (participants in the mythologised partisan movement) transformed the abstract historical narrative learned from textbooks into a living, personalised, and emotionally charged experience. This made distancing and critical reflection on the past virtually impossible, fostering a durable affective bond with the official ideology (Vukov, 2008).

An important stage in the development of ideological education was the adoption in 1959 of the Law "On the Link between School and Life and the Further Development of Public Education". This law marked a shift from predominantly passive assimilation of ideology (studying theory, memorising dates) to an active one (the practical implementation of ideology). The main goal of the law was declared to be the "preparation Bulgarian youth for life in a socialist and communist society". The key mechanism for achieving this aim was defined as "the combination of education with socially useful and productive labour". The law also introduced structural changes: compulsory eight-year schooling and the creation of the twelve-year "comprehensive polytechnical school" (later reduced to eleven years). The significance of this law for the teaching of history was profound: the historical narrative of the "heroic labour" of the working class and of industrialisation as a progressive stage now had to be reinforced through pupils' physical participation in "productive labour". Pupils were required to work in factories, industrial plants or agricultural cooperatives. Thus, history education ceased to be a purely humanities-based, academic discipline. It became an ideological justification for polytechnical education and labour training. Pupils first learned in history lessons about the "heroism" of labour, and then went to "work", reproducing and validating through their practical activity the historical narrative provided by the state. This system was abolished only at the end of 1989.

Reforms and narrative transformations in the teaching of history after 1989

The fall of the socialist regime in November 1989 initiated contradictory transformations within Bulgarian society. As the education system in Socialist Bulgaria functioned as an instrument of ideology, it naturally became a central arena of change. A complex, multi-stage and non-linear process began to unfold, involving the deconstruction of the socialist canon in the teaching of history. At the same time, a new post-socialist historical narrative was emerging – one that likewise acquired ideological functions aimed at legitimising the new socio-political and economic order (Dainov, 2007). The reform of the education system, particularly in the field of history teaching, was not a single event but passed through several conflict-laden phases, reflecting the wider political and ideological struggles within the country (Table 2).

Table 2. Comparative characteristics of the stages of educational reform in Bulgaria in the post-socialist period

Category	Phase 1 (1990-1997)	Phase 2 (1997-2007)	Phase 3 (after 2007)
Chronology and context	1990-1997: Post-socialist transition	1997-2007: Beginning after the political and economic crisis and the collapse of the socialist government in 1997	After 2007: Directly caused by Bulgaria's accession to the EU
Key characteristic	Initial deregulation and intense ideological confrontation	Administrative modernisation and standardisation	Shift of emphasis from administrative modernisation to a competence-based approach
Driving forces	Reformers (at the political level). Opposition: "old nomenklatura cadres" in local administrative structures, BSP, Minister of Education I. Dimitrov	New Union of Democratic Forces government	EU (as a source of funding and standards)
Key measures	Abolition of explicitly ideological subjects (e.g., "scientific communism"). Revision of school curricula. Emergence of the first alternative textbooks (for example, from the "Prosveta" publishing house)	Renewed commitment to reform. General harmonisation of the education system with Western European standards	Funding through EU Operational Programmes (notably "Human Resources Development"). Implementation of ECTS

Table 2. Continue

Category	Phase 1 (1990-1997)	Phase 2 (1997-2007)	Phase 3 (after 2007)
Legislative framework	Higher Education Act of 1995	Amendments to the to the Higher Education Act (1999)	Amendments to the Preschool and School Education Act (PSEA)
Declared objectives	Dismantling of the state monopoly over educational content	Creation of new academic degrees. Establishment of agencies for quality assurance and accreditation	Transition from "mechanical reproduction of knowledge" to "the development of competences and life skills". Development of ICT skills and "lifelong learning"
Identified obstacles/ resistance	Implementation was not linear. Resistance and sabotage by local administrative structures that preserved a "corporate culture oriented towards control". The BSP's return to power in 1994 and the appointment of I. Dimitrov, who had "sabotaged... reforms" as early as the 1980s. I. Dimitrov "effectively halted" reforms, calling them "treacherous" on 15 September 1995 and accusing the EU and the Open Society Foundation	Modernisation was described as "superficial and administrative". It confronted the reality of low educational quality	
Concrete outcomes	Emergence of a market for alternative textbooks, notably "Prosveta" and "Anubis". Political blockade and the effective freezing of reforms (after 1994)	Testing (1997/98): 25% of Year 4 pupils failed to reach the minimum knowledge threshold (Bulgarian language, mathematics). Study (2004): Only 38% of employers believed that the education system provided young people with the necessary skills	Implementation of ECTS in higher and vocational education. Development of programmes aimed at ICT skills and "lifelong learning"

Note: ECTS – European Credit Transfer and Accumulation System; BSP – Bulgarian Socialist Party; ICT – Information and Communication Technologies
Source: compiled by the author based on E. Dainov (2007), Operational Programme Human Resources Development (2025)

The analysis of the data presented in the table demonstrated the non-linear trajectory of educational reforms in Bulgaria, the dynamics of which were largely determined by the political conjuncture. The initial phase was characterised by institutional confrontation between reformist forces and the post-communist nomenklatura, primarily the BSP, which resulted in the blockage of transformational processes at the local level. Institutional stabilisation and the restoration of a westernising vector occurred during the second phase under the governance of the Union of Democratic Forces. The third phase, driven by the imperatives of European integration, was marked by the implementation of structural mechanisms, in particular the ECTS, and by the normative consolidation of standards in the Law of Bulgaria No. 112-27 "On Higher Education" (1955). At the same time, systemic deficits in the quality of education, objectified by the 1997/98 testing, had a prolonged negative impact, highlighting the need for a shift towards a genuinely competence-based paradigm.

Institutional reforms were accompanied by a radical narrative inversion in the content of history education. A complete transformation of terminology and evaluative frameworks took place: previous discussions about the "beginning of socialism" in Bulgaria were instantaneously transformed into debates about the "beginning of totalitarianism". This term, previously prohibited in official discourse, became the dominant framework for describing the entire period from 1944 to 1989. The key concepts used to describe the establishment of the regime became "Sovietisation" and the "one-party system". A fundamental revision of key historical figures and events followed. In particular, G. Dimitrov, who had previously occupied a central place in the official ideological canon, acquired radically opposing interpretations within the new discourse, being portrayed, for example, as an "instrument of Stalin", a "conduit of Sovietisation", and a "destroyer of democratic opposition" in Bulgaria (Sygkelos, 2011). The People's Court of 1944-1945, which had earlier been presented as an act of "class justice", was now unequivocally described as a "parody of legality" and an instrument of mass repression. Crucially, the very function of ideology in the teaching of history changed: whereas the former Marxist-Leninist ideology had served to legitimise the rule of the Bulgarian Communist Party, the new anti-totalitarian rhetoric began to function as a means of sanctioning and legitimising the new, contested "transition to the free market and democracy" (Rönkkö, 2021).

In order to justify and substantiate the new neoliberal consensus (often described as There Is No Alternative), the socialist past had to be demonised. This led to the emergence in academic and educational discourse of two competing, though unequal, approaches to describing the period. The first, "totalitarian socialism", focuses on the repressive nature of the regime, ideological control, crimes, and the absence of civil liberties. The second, "state socialism", offers a more neutral socio-economic analysis, describing institutional features, the planned economy, and the "greyness" of everyday life under the regime. In school textbooks, which require clear and unambiguous formulations, the "totalitarian" framework became dominant, as it was more suitable for the political objective of demonising and delegitimising the past (Dainov, 2007).

In the process of simplifying the forty-five-year period for educational purposes, a pronounced personalisation took place. The entire socialist period, especially its later phase, increasingly came to be associated with a single individual – T. Zhivkov, who led the country for thirty-five years (1954-1989). This era is persistently linked to his figure, as well as to his native town of Pravets, which received privileges and infrastructure investments during his rule. Such a focus on the personality of the dictator, rather than on an analysis of the system itself (political, economic, and ideological), leads to a depoliticisation of analysis. It creates space for the coexistence of seemingly incompatible elements – a general critique of "totalitarianism" as an abstract system alongside a widespread social nostalgia for "stability", "social protection", and "prosperity", which are associated precisely with the period of T. Zhivkov's rule. This social ambivalence has been directly reflected in new school textbooks, particularly those proposed in 2019 in response to the new 2018 curriculum. These textbooks provoked public controversy and accusations of "whitewashing" T. Zhivkov. Despite an overall critical framework of totalitarianism, some texts contained claims that T. Zhivkov had a "moderate style of governance without harsh repression". Others argued that his policies were aimed at "improving the population's well-being", and that dissatisfaction with the lack of civil rights was "appeased" by rising living standards. This personalisation and the positive connotation of a specific leader constitute a convenient narrative that reflects the unresolved and contradictory attitude of contemporary Bulgarian society towards its socialist past (Simeonova & Synovitz, 2019).

The study of educational practices after 1989 has shown that, despite the formal de-ideologisation of curricula and the proclamation of new objectives (competences, European integration), an instrumental approach to the teaching of history has persisted. Ideological influence did not disappear but rather transformed, shifting from direct, overt propaganda (as in the period 1944-1989) to "soft", latent, and "hidden" forms. This observation corresponds with broader socio-legal analyses demonstrating that modern states increasingly rely on institutional narratives and normative frameworks to legitimise political choices and shape collective perceptions without resorting to explicit ideological coercion (Berezniak *et al.*, 2023). This influence operates less through the explicit content of textbook paragraphs and more through the so-called "hidden curriculum". This term refers to unspoken patterns of thinking, institutional practices, biases, and structural constraints that shape pupils' attitudes towards the past, often bypassing the stage of critical analysis. The "hidden curriculum" teaches pupils "how" to perceive problems rather than "what" to know about them (Koleva, 2022).

One of the key mechanisms of "soft ideologisation" is the conscious or unconscious restriction of the source base used in teaching. Contemporary textbooks and lessons, despite the requirements of the 2018 curriculum, rarely engage in detailed discussion of the "realities of life" under totalitarianism. Research points to the absence in school curricula of personal sources ("history from below") and analyses of everyday life. There is also no exploration of how the population perceived its reality as "normal", in contrast to the political narrative emphasising the repressive nature of the period. Projects such as "I Lived through Socialism" or "The Inventory Book of Socialism", which collected personal stories and artefacts, exist in the media sphere but are weakly represented in schools (Genova & Gospodinov, 2006). Particularly striking is the lack of in-depth study of the "history of repression". Although repression and the People's Court are mentioned as facts, there is no detailed analysis of the specific experiences of particular repressed groups (Kamusella, 2019). For example, the experiences of Muslim minorities, including Pomaks and Turks, who were subjected to forced assimilation campaigns and name changes, are effectively marginalised within the educational process. Similarly, the oral history of women in labour camps or the gender dimension of repression rarely become topics of classroom discussion, despite the importance of such sources for understanding the full picture. The source base of teaching is dominated by official documents of state and party origin, namely Politburo decisions, party archives, and legislative acts. As a result of the predominance of state-oriented sources, pupils study the history of the state and the history of the regime (even if this history is now presented from a critical perspective), rather than the history of society in all its complexity and diversity. This makes a multidimensional analysis impossible and reduces a complex forty-five-year period to a simple binary scheme of a "repressive state versus a silent people". A second mechanism of "soft control" is the "examination effect", in particular the influence of the state matriculation examinations. Pedagogical practices in real classrooms are shaped not only by the official curriculum, but also by pressure from parents and school administrations, who demand high academic results. In turn, the "hidden curriculum" dictates how problems should be perceived, not merely what should be known about them (Gigova, 2023). Under pressure to achieve results in standardised assessments, teachers are compelled to focus on what is tested in external examinations. The structure of standardised tests reproduces curricular priorities; thus, minimal attention to the analysis of the socialist past during instruction leads to a corresponding reduction of this topic in examination tasks. Teachers, rationally allocating limited teaching time, devote even less attention to these themes, concentrating instead on factual material required for the tests. In this way, the examination functions as a formally non-ideological, purely administrative instrument. In practice, however, it institutionally entrenches the marginalisation of complex topics, achieving an ideological outcome (the avoidance of in-depth analysis) without any explicit ideological directive (Koleva, 2022).

The most effective mechanism of "soft ideologisation" and "structural silencing" has proven to be the very design of the curriculum itself. The topic of the socialist

period (1944-1989) and the post-socialist transition after 1989 is placed at the very end of the Year 12 curriculum (Zajda, 2024). This topic is only one of nine broad themes covering an extensive chronological span from antiquity to the present. Occupying the smallest proportion of textbook content, and positioned chronologically at the end of the course, it is systematically pushed to the margins of the educational process. This is due to the objective shortage of classroom time and the priority given to preparing pupils for state examinations (Koleva, 2022). Such chronological placement institutionally ensures that most pupils complete their schooling without having systematically studied the most important and most complex period, which directly shaped their present and the society in which they live. Whereas in 1944-1989 ideology was achieved through excessive emphasis on and foregrounding of the "anti-fascist resistance", in the contemporary period (the 2020s) a similar instrumental approach is achieved through the opposite method – structural marginalisation. In both cases, the outcome is similar: the avoidance of critical, in-depth, and multidimensional engagement with the period (Neuburger, 2022).

The cumulative effect of these "soft" mechanisms – restricted sources, examination pressure, and structural marginalisation within the curriculum – is the exclusion of socialism as a subject of critical analysis in the classroom. The "hidden curriculum" teaches pupils how to perceive the past, rather than what it actually was. The pedagogical discourse transmitted by teachers is characterised by an uncritical acceptance of Western models, reproducing a new binary opposition. Research indicates (Sierp, 2023) that in contemporary teaching Western Europe is "almost idealised" and presented as the "apex of global culture and development". The socialist period, by contrast, is treated as an "already known" evil, something that does not require in-depth analysis but merely formal condemnation. Due to a lack of time, the absence of sources "from below", and institutional constraints, schools do not challenge this binary opposition but rather reinforce it. The socialist period has shifted from a canonised and excessively emphasised past to one that is silenced and marginalised. It is not analysed, but instead used as a negative mirror and as a means of legitimising the country's current pro-European consensus and political orientation (Dragostinova, 2022). At the same time, it remains misunderstood, unreflected upon, and mythologised – either through nostalgia or demonisation – for the new generation.

DISCUSSION

The analysis of the research findings demonstrates that the instrumentalisation of historical scholarship and education in Bulgaria functioned as a mechanism of power. During the communist regime (1944-1989), history was transformed into an ideological apparatus designed to legitimise class struggle and socialism through institutional control, censorship, and didactic practices. Post-communist reforms after 1989 did not dismantle this logic but rather inverted the narrative: Marxist dogma was replaced by an anti-totalitarian rhetoric, while the instrumental approach itself was preserved through the hidden curriculum, the structural marginalisation of certain topics, and a strong focus on personalisation. As a result, the past continues to be mythologised rather than subjected to sustained critical analysis. The broader significance of this finding lies in its illustration of a universal dynamic of power, whereby control over historical discourse shapes collective identity, obstructs genuine de-ideologisation, and underscores the necessity of pluralistic approaches in education in order to break cycles of manipulation in transitional societies. In this sense, the Bulgarian case contributes to a deeper understanding of post-socialist transformations and their long-term social consequences.

L. David (2020), in her work on forced memorialisation, provided a useful comparative framework for interpreting these findings. The researcher argued that the institutional imposition of particular memory regimes in the name of human rights often fails to generate social cohesion and instead produces new forms of alienation and formalised engagement with the past. L. David emphasised that the bureaucratisation of historical memory transforms traumatic events into standardised narratives that lose their emotional and ethical force, becoming instruments of political correctness rather than vehicles for deep reflection. A similar tendency was identified in the context of Bulgarian school education, where the introduction of "European" competence-based frameworks and civic education largely remained declarative, while everyday school practice continued to reproduce uncritical modes of perception. Whereas L. David focused primarily on the moral and ethical consequences of such policies at the societal level, this study demonstrates how standardised testing and chronological curriculum design technically sustain this superficiality, reducing the complex history of totalitarianism to a set of "correct" examination answers. In doing so, it empirically confirms L. David's thesis regarding the limited effectiveness of formalised memory mandates.

The intellectual dynamics of late socialism in Bulgaria have been analysed by G. Medarov & V. Stoyanova (2024), who challenge the rigid dichotomy between power structures and dissidents by revealing an intermediate space of ambivalence. Within this space, intellectuals combined institutional cooperation with the regime and strategies aimed at expanding the boundaries of ideological autonomy. The authors argued that the period of T. Zhivkov's rule was characterised by complex strategies of adaptation and cultural manoeuvring that cannot be captured by simplified models of total subjugation or heroic resistance. The results of the present study, based on an analysis of state educational standards and curriculum structures, highlighted a clear discrepancy between this academic complexity and the school narrative. This divergence can be explained by the differing functions of these texts: while academic scholarship seeks to restore historical complexity, school textbooks perform a legitimising function by

means of "narrative inversion" and the construction of a clearly defined "other" (the totalitarian past). This function necessitates the elimination of ambiguity and ambivalence, which are intrinsic to real historical processes.

The symbolic temporality of violence during late socialism has been examined by N. Ragaru (2023), who focused on memory practices related to the so-called "Revival Process". The study demonstrated that the inclusion or exclusion of these events from the national historical narrative has been shaped by contemporary political conjunctures. The researcher emphasised that violence against minorities has been subject to manipulation, with victims either marginalised or instrumentalised for political purposes without being granted genuine subjectivity. The findings of the present study corroborate this conclusion through an analysis of educational curricula, which reveals the "structural silencing" of the specific experiences of Pomaks and Turks. In contrast to the author's approach, which focused on the analysis of a wide range of cultural memory and public discussions, this study focused on institutional determinants. It was established that the dominance of official sources in textbooks creates structural barriers to the integration of oral history and the traumatic experience of minorities, as such narratives do not align with the canonical version of political history based on the ethnocentric state tradition.

L. Ricou (2020) analyses the processes of "Europeanisation" of educational systems in the post-socialist space, examining how the idea of "Europe" is employed in nation-building projects and in the reconfiguration of pupils' historical consciousness. The author noted that integration into the European educational space is often perceived by local elites as an external resource for legitimising their own power and for symbolically distancing themselves from the communist past. This, in turn, leads to the construction of new myths about the nation's "primordial Europeanness". This observation directly correlates with the findings of the present study regarding the third phase of educational reforms in Bulgaria (after 2007), during which a shift towards a competence-based approach was identified under the influence of EU funds and frameworks. At the same time, the study reveals the largely formal and declarative character of this "Europeanisation": despite the rhetorical embrace of European values, nationally centred narratives remained dominant, while the concept of totalitarianism functioned primarily as a tool of moral discrediting of the previous regime rather than as a means of fostering critical thinking. This confirms the instrumental use of the "European idea" within the educational field.

K.R. Ghodsee & M.A. Orenstein (2021), in their analysis of the social consequences of post-1989 transformations, argued that the implementation of radical market reforms in Central and Eastern Europe required the construction of a specific ideological narrative designed to justify sharp declines in living standards and growing inequality through the comprehensive demonisation of the socialist past. They demonstrated that political rhetoric emphasising the inevitability of market transition depended on the erasure of memories of social security and welfare under the previous system, presenting socialism exclusively as a historical aberration. The present study provides direct empirical confirmation of this macro-sociological argument at the level of Bulgarian school education. It documents the total dominance of the totalitarian paradigm and the systematic exclusion from curricula of any references to social stability or the perceived normality of everyday life during socialism. The narrative inversion identified in textbook analysis – reducing the entire 45-year period to repression and economic failure – demonstrates how the school system performs a legitimising function for the new neoliberal order described by K.R. Ghodsee & M.A. Orenstein. In doing so, it blocks the possibility of critical comparison between social models and turns history into an instrument for justifying contemporary economic realities.

The mechanisms of ideological indoctrination through primary education have been examined in detail by J. Wojdon (2021). Focusing on primers and textbooks from former Soviet bloc countries, she demonstrated the role of visual imagery in constructing a world view presented as without alternatives. J. Wojdon showed how images and simplified texts shaped the outlook of the youngest citizens, producing a coherent narrative in which the party and the Soviet Union appeared as guarantors of a happy future. The findings of the present study, which focuses primarily on upper secondary education and history courses, complement her conclusions by revealing the continuity and institutional depth of this control. Whereas J. Wojdon analysed content – what was taught – this research uncovers the institutional mechanisms – how control was exercised – such as the role of Glavlit, special library collections, and the centralisation of academic institutions like the Bulgarian Academy of Sciences. A further distinction lies in the focus on transformation: this study demonstrates that after 1989 the mechanisms of direct propaganda described by J. Wojdon did not disappear, but were reconfigured into "soft" forms of influence, including curriculum structure and examination regimes. These mechanisms continue to shape historical consciousness, not through overt indoctrination, but through exclusion and silence.

Overall, the analysis confirms that the instrumentalisation of historical education in Bulgaria has evolved from the direct ideological indoctrination characteristic of the socialist period into "soft" forms of legitimising the new socio-political order. Instead of overt censorship and Marxist dogma, the contemporary system relies on institutional mechanisms such as the hidden curriculum and the structural marginalisation of inconvenient topics to assert the non-alternative nature of the anti-totalitarian narrative. The identified trends demonstrate that a formal change of ideological signifiers and the declaration of European values have not ensured a transition to genuine critical pluralism. History continues to function as a resource for political mobilisation and for legitimising market reforms, rather than as a space for sustained, critical engagement with the past.

CONCLUSIONS

A comprehensive analysis of the mechanisms through which history education has been instrumentalised in Bulgaria made it possible to identify both the continuity and the specificity of the transformation of ideological practices under two distinct political regimes. With regard to the period 1944-1989, it was established that ideological control did not end with content censorship but was enacted through an institutional restructuring of the humanities. The relocation of the centre of historical research to the Bulgarian Academy of Sciences and the creation of the Glavlit system ensured the vertical integration of scholarly knowledge with the directives of the Bulgarian Communist Party. An examination of regulatory documents, in particular the 1959 Law on the Link between School and Life, demonstrated how Marxist-Leninist methodology was didacticised through the introduction of the theory of socio-economic formations and compulsory "productive labour". This transformed history from an academic discipline into an instrument for legitimising power, with the "foundational myth" of 9 September 1944 serving as a basis for shaping the loyalty of the "new person".

A key outcome of the study was the identification of control mechanisms ("soft ideologisation") that persist in the contemporary education system despite the implementation of European competence frameworks. The research demonstrated that the structural placement of the topic of socialism at the very end of the Year 12 curriculum and the focus on standardised examinations operate as effective instruments of "structural silencing", technically limiting the time and depth available for studying the material. A deficit of personal-source materials was identified, as well as the effective exclusion of the traumatic experiences of ethnic minorities – particularly the Turkish community during the "Revival Process" – from the official canon. This confirmed the thesis that contemporary history education continues to perform the function of constructing national identity through selective memory, ignoring complex and controversial aspects of the past for the sake of preserving a consensus political narrative.

A limitation of the present study was the fragmentary archival availability of complete textbooks issued in the 1950s. This factor has somewhat complicated the detailed reconstruction of the full range of didactic tools used during the early phase of the period under investigation, in particular preventing an in-depth analysis of the specific features of visual propaganda and the primary methodological directives. Future research may focus on conducting a comparative analysis of curricula in other Eastern European countries that have undergone post-socialist transformation – such as Poland, Romania, Hungary and the Baltic states. Such an approach would allow for the verification of the hypothesis concerning the universality of the identified mechanisms of "narrative inversion" and the identification of shared regional patterns in the implementation of state memory politics.

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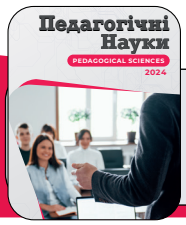
Освіта як інструмент ідеології: викладання історії в болгарських школах за часів соціалізму (1944-1989) та в наш час

Анотація. Дослідження інструменталізації історичної освіти для ідеологічної легітимації влади залишається актуальним як для розуміння механізмів соціалістичних режимів, так і для аналізу суперечливих процесів постсоціалістичної трансформації. Метою дослідження було виявити еволюцію механізмів державного контролю над історичною освітою в Болгарії шляхом порівняльного аналізу інструментів прямої індоктринації в соціалістичний період (1944-1989) та прихованих форм ідеологізації в наш час. Методологія базувалася на проблематично-хронологічному підході, поєднуючи аналіз інституційних змін у болгарській освітній політиці та нормативно-правових актах з дослідженням трансформації історичних наративів та освітніх програм в обох періодах. Результати дослідження показали, що в період з 1944 по 1989 рік в Болгарії була сформована загальна система ідеологічного контролю, заснована на інституційній підпорядкованості науки Болгарській академії наук, цензурних обмеженнях з боку Главліту та нормативному встановленні марксизму-ленінізму як єдиної методології. Встановлено, що завдяки впровадженню Закону 1959 року про зв'язок школи з життям історична освіта була інтегрована з промисловою практикою, ставши інструментом виховання лояльності через працю, а наратив був зосереджений на «міфі заснування» 9 вересня 1944 року та класовій боротьбі. Було продемонстровано, що після 1989 року відбулася не деідеологізація, а «інверсія наративу», в якій соціалістичний канон був замінений риторикою тоталітаризму для легітимізації ринкових реформ. Аналіз виявив перетворення прямого тиску на «м'які» механізми контролю – структурне переміщення теми соціалізму на кінець 12-го класу, акцент на стандартизованих іспитах, що вимагають запам'ятовування фактів, а не аналізу, та систематичне ігнорування особистих джерел і травматичного досвіду етнічних меншин (особливо під час «процесу відродження»), що блокує формування критичного осмислення минулого. Практичне значення дослідження полягає в представленні моделі аналізу довгострокового ідеологічного впливу на освіту та наданні інструментів для виявлення «прихованих» механізмів інструменталізації

Ключові слова: тоталітаризм; історіографія; індоктринація; комунізм; суспільство



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Methodological aspects of improving the information and digital competence of technology teachers in general secondary education institutions

Abstract. The purpose of the study was to provide a comprehensive analysis of the level of information-digital competence formation among technology teachers in general secondary education institutions and to substantiate methodological approaches to its improvement. The study employed content analysis of scientific sources, regulatory and legal documents, as well as a synthesis of findings from Ukrainian and international monitoring studies. The study identified key barriers hindering the development of information-digital competence among technology teachers in general secondary education institutions. These included outdated technical infrastructure, limited access to modern digital equipment and resources, fragmented and unsystematic professional development, as well as the lack of adapted methods for assessing digital skills. These factors complicated the integration of digital technologies into the educational process, reduce the effectiveness of teaching practices, and impede teachers' professional growth. To address the identified challenges, a multi-level model for enhancing digital competence was proposed. At the institutional level, it involved developing a digital strategy for the educational institution, strengthening internal support for digital initiatives, fostering digital culture, and ensuring access to digital resources. The individual level included personalised professional development trajectories, consideration of motivational factors, initial competence levels, access to resources, as well as the implementation of mentoring programs and digital coaching. The methodological level encompassed the systematic integration of tools into the educational process, adaptation of learning materials to online formats, development of professional communities of practice, formation of digital pedagogy, and support for innovative educational solutions. The practical significance of the research lies in formulating specific recommendations for the administration of general secondary education institutions, methodological services, and teachers themselves regarding the creation of a supportive learning environment that promotes sustainable development of digital skills. The proposed approaches can be integrated into professional development programs, internal evaluation systems, and strategic planning for the digital transformation of educational institutions

Keywords: DigCompEdu; methodological approaches; professional development; digital transformation

INTRODUCTION

The development of the information-digital society and the rapid integration of innovative technologies into all spheres of human activity, particularly in education, are fundamentally changing the perception of the role and functions of the modern teacher. These transformations impose new, more complex requirements on the professional competencies of educators, who must not only possess basic knowledge but also be capable of adapting to a dynamic digital environment, thinking critically, creatively using digital tools, and ensuring high-quality teaching in

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conditions of constant change. During the so-called Fourth Industrial Revolution, characterised by the convergence of physical, digital, and biological technologies, the digitalisation of education is no longer merely a trend – it has become an urgent necessity that determines the competitiveness of the educational system as a whole (Diia.Osvita, n.d.). The effectiveness of this process directly depends on the level of teachers' digital literacy, their ability to integrate digital resources into curricula, use online platforms, virtual environments, artificial intelligence, and other technologies to enhance student motivation and the quality of the educational process.

In Ukraine, information and digital competence (IDC) is officially recognised as one of the ten key competencies defined by the New Ukrainian School Concept (Resolution of the Cabinet of Ministers of Ukraine No. 988-2016, 2016). This highlights its fundamental importance for modern pedagogical practice, as IDC encompasses not only technical skills but also the ability to use digital technologies safely, ethically, and responsibly. Developing this competence is critically important for ensuring equal access to quality education, fostering an inclusive learning environment, and preparing students for life in a digital world. A review of research and scientific publications on this issue demonstrates the scientific community's deep awareness of the critical importance of developing teachers' digital competence in the context of educational transformation. In the works of I. Ivaniuk & O. Ovcharuk (2022), as well as N.V. Morze & A.B. Kocharian (2023), digital competence is considered not merely as a set of technical skills but as a complex structure that includes five key components: information literacy, effective digital communication, creation and editing of digital content, cybersecurity, and problem-solving in the digital environment. Such an approach allows for a deeper understanding of digital competence as both a tool for teachers' professional development and a means of improving the quality of education.

The analysis of monitoring results conducted in the 2024-2025 academic year in Kyiv (State Service for Education Quality of Ukraine, 2025) confirms that despite the generally high level of media literacy among Ukrainian educators, there remain systemic challenges that hinder the full digital transformation of the educational process. In particular, significant infrastructural limitations have been identified-lack of modern equipment, unstable internet connectivity, as well as methodological difficulties related to the absence of clear algorithms for integrating digital tools into curricula. The studies of A. Ponomarenko (2024) emphasise barriers of both technical and pedagogical nature. These include the use of outdated equipment that does not support modern educational platforms, as well as insufficient teacher training in the didactic use of digital technologies. This encompasses not only knowledge of tools but also an understanding of their potential for developing critical thinking, personalising learning, and creating an inclusive educational environment.

In conditions of digital transformation of education, which is an integral part of global socio-technological changes, the formation and development of teachers' IDC is becoming especially relevant (Shpak & Bardadym, 2022). Scientific research by O.P. Tretiak (2023) not only highlights the issues of insufficient digital preparedness of educators but also provides theoretical and practical foundations for developing effective strategies for its improvement. Teachers' digital competence is regarded as a key factor in the successful implementation of educational reforms aimed at modernising the content, forms, and methods of teaching in response to the challenges of the information society (Samoylenko *et al.*, 2022).

The relevance of this study is determined by the need to develop a holistic, scientifically grounded methodological approach capable not only of overcoming the identified infrastructural, organisational, and competence-related barriers but also of transforming teachers' theoretical knowledge into effective educational practices. As noted by O. Spirin *et al*. (2024), existing models of digital competence development still demonstrate fragmentation, particularly in aligning institutional requirements with teachers' actual digital practices; therefore, a unified conceptual framework remains essential. Research by D. Kolomiiets *et al*. (2018) demonstrates that technology- and design-oriented learning activities significantly intensify students' engagement only when teachers themselves possess a sufficiently high level of technological and methodological preparedness. Furthermore, N. Soroko & L. Mykhailenko (2019) emphasise that the integration of STEAM and Information and communications technology (ICT) components into the educational process requires the development of IDC as an integral element of pedagogical mastery, highlighting that digital competence functions not as an isolated skill but as a systemic characteristic influencing instructional design, assessment strategies, and communication with learners. The aim of this study was to systematise and develop the scientific and methodological aspects of improving technology teachers' IDC. Within the framework of the research, the following tasks were set: clarifying the conceptual framework of IDC, analysing its key components – information literacy, digital communication, content creation, security, and problem-solving.

MATERIALS AND METHODS

The research methodology was based on a combination of theoretical analysis and secondary processing of empirical data. A systematic analysis of scientific publications, regulatory documents, and international digital competence frameworks was conducted, including DigCompEdu (European Commission, n.d.), UNESCO (2021; 2023), the Conceptual and Reference Framework of Digital Competence for Pedagogical Staff in Ukraine (Diia.Osvita, 2021), and the Professional Standard for Teachers (Order of the Ministry of Education and Science of Ukraine No. 1225, 2024). Scientific publications were selected according to criteria of relevance, scientific novelty, and alignment with the

research subject. The analysis included publications from 2017-2025 indexed in Scopus and Web of Science, as well as official analytical reports of educational institutions. The search was performed using key terms ("digital competence", "teacher digital skills", "ICT in education", "DigCompEdu", "digital pedagogy"), ensuring comprehensiveness and systematicity in the selection of source materials.

The empirical basis of the study consisted of secondary data from the official monitoring conducted by the State Service for Education Quality of Ukraine (2025). The monitoring covered more than 332 technology teachers from different regions of Ukraine and included information on teachers' digital skills, the state of digital infrastructure, and practices of using digital tools in the educational process. Since the authors did not collect primary data, all sampling parameters, instruments, and data collection procedures were determined by the State Service for Education Quality. The secondary analysis of aggregated statistical indicators involved the use of descriptive statistics, analytical grouping, and comparative analysis. This made it possible to identify key barriers to the development of teachers' IDC, including the fragmented integration of digital tools, lack of methodological support, and significant disparities in material and technical resources across educational institutions.

Within the framework of the international comparative analysis, approaches to developing teachers' digital competence in Finland and Germany were examined. The analysis of documents issued by the Finnish National Agency for Education (2025) made it possible to identify key emphases on supporting creativity, integrating STEAM-oriented practices, and fostering professional teacher communities. In the German context, the central concept was "digital sovereignty", which encompassed the critical, responsible and informed use of digital technologies. The methodological review of German policy and regulatory documents enabled the identification of the prioritisation of ethical, legal and security aspects of digital interaction, as well as the autonomy of schools and teachers in selecting digital solutions (University of Tübingen, n.d.; Meinel *et al*., 2023). The comparison of the Finnish and German models with the Ukrainian educational context made it possible to determine adaptive elements relevant to developing the digital competence of technology teachers.

RESULTS AND DISCUSSION

IDC in the modern educational space is viewed as a complex, integrative construct that extends far beyond purely technical skills in using digital devices and software. As noted in the study conducted by the Naurok (2025) platform, this concept encompasses not only proficiency with application software but also a deep understanding of the essence of processing, analysing, and transmitting information. IDC develops at the intersection of several key components, each with its own specifics and significance for the professional activity of a teacher. O. Storonska & M. Vorobel (2023) defined digital competence as an integrative personal quality that includes the ability to recognise and identify information needs, effectively process educational information using digital technologies, and utilise appropriate resources, software, and technical tools for professional activities. The researchers outlined four key components of this competence and identified the conditions conducive to its development: motivation to use digital technologies, the creation of a digital educational environment, and the focus of professional training content on the development of digital skills.

International publications indexed in Scopus and Web of Science confirm the relevance of the issue. The European DigCompEdu framework (Redecker, 2017) defines five key components of teachers' digital competence: information literacy, communication, digital content creation, security, and problem-solving. Studies, conducted by J. Cabero-Almenara *et al*. (2021) and S. Tkachov *et al*. (2023) indicated that the greatest challenges arise in transitioning from theoretical training to the practical application of digital technologies. In Finland, emphasis is placed on strengthening teachers' confidence in integrating ICT into teaching as well and on developing professional communities and mentoring systems, as evidenced by the Scandinavian experience analysed by I. Ivaniuk (2019). In the United States, similar approaches are observed, where methodological foundations for ICT integration and forms of professional support are systematically developed, particularly in STEM and engineering education (Kiianovska *et al*., 2018). A significant problem highlighted by researchers is teachers' low self-assessment of their digital competence. Even when they possess the necessary knowledge, educators do not always confidently apply it in practice, as noted by O.V. Sakhno (2020). It was suggested to address this problem through a combination of self-assessment and external monitoring tools, as well as through the creation of practice-oriented methodological materials that demonstrate successful cases of ICT implementation.

Special attention in the literature is devoted to digital security. S. Tolochko (2021) suggested that technology teachers who actively use online resources and digital platforms often face risks associated with cybersecurity and the ethics of using information technologies. It is considered that the inclusion of digital security modules in professional development programs, the use of simulation tasks, and the development of digital behaviour codes in educational institutions as essential solutions. Among new challenges is teachers' readiness to use artificial intelligence technologies. Y. Kulyk *et al*. (2022) show that technology teachers and teachers of other subjects are not yet prepared to integrate AI tools into the learning process due to a lack of relevant methodological materials and training programs. Researchers propose introducing specialised digital literacy courses on artificial intelligence and fostering cooperation with IT companies to create resources adapted to the school environment.

Summarising the analysis, it can be concluded that the main problematic aspects of developing IDC among

technology teachers are: the gap between theoretical and practical training, low self-assessment of skills, lack of methodological support, challenges in digital security, and the integration of advanced technologies, particularly artificial intelligence. Solutions lie in systematic methodological support, practical training, the development of professional communities, expanding the material and technical base of educational institutions, and creating conditions for teachers' continuous professional development. Thus, the analysis of scholarly sources indicates that IDC is a multidimensional phenomenon that encompasses technical, cognitive, communicative, and ethical aspects. Its development is a necessary condition for the successful professional activity of teachers in the context of a digital society and rapid technological change.

For technology teachers, this issue is especially relevant, as they are responsible for integrating applied innovations into school practice, including STEM education, robotics, 3D modelling, and other digital tools. These findings align with national requirements for teachers' digital competence, as established in the Order of the Ministry of Education and Science of Ukraine No. 1225 (2024). The development of digital competence is considered as one of the key factors for effective professional activity of educators. Based on monitoring data collected in Kyiv (State Service for Education Quality of Ukraine, 2025), it was found that despite the high level of media literacy among Ukrainian educators there are significant infrastructural and systemic barriers. In particular, schools face worsening access to computer equipment and multimedia tools, which complicates the implementation of digital innovations in the educational process. This is also confirmed by Arbook (n.d.) pointing to the widespread problem of outdated equipment and unequal access to high-speed internet.

At the same time, the lack of a coherent strategy for education digitalisation leads to the fragmentation of individual initiatives, a pattern also described by UNESCO (2023), which do not ensure a systematic approach to IDC development. Technology teachers, as carriers of practical knowledge and skills, should be not only users of digital tools but also active participants in their integration into curricula. This implies the use of cloud services, distance learning platforms, digital laboratories, as well as augmented and virtual reality technologies. An effective means of enhancing IDC is microlearning – short online courses, webinars, and training sessions covering topics of digital security, STEM approaches, and robotics.

International experience, particularly the Finnish model, highlights the importance of teacher trust and autonomy (Finnish National Agency for Education, 2025). Teachers are encouraged to experiment and continuously develop, while instruction is based on STEAM approaches and project-based learning (Experience Workshop, 2025). Educators are given freedom in choosing teaching methods, digital tools, and the pace of professional growth. Such an approach fosters an environment where experimentation, innovation, and continuous improvement are the norm. Learning in Finland actively integrates STEAM, combining science, technology, engineering, arts, and mathematics. Educational programs emphasise project activities, interdisciplinary collaboration, and the development of creative thinking. Within initiatives such as Experience Workshop, teachers participate in training sessions that help them create learning environments stimulating creativity, critical thinking, and teamwork. Importantly, digital technologies in Finnish schools are not used solely as tools but also as a means of personalising learning, supporting diverse learning styles, and ensuring inclusivity. These characteristics align with broader research-based analyses of the Finnish system, which emphasise that trust-based governance and teacher autonomy are foundational elements enabling educators to take responsibility for technology-rich pedagogical decisions (Chung, 2023).

In Germany, the focus is placed on "digital sovereignty", which combines practical skills with a reflective attitude toward technology (University of Tübingen, n.d.; Meinel *et al.*, 2023). This concept covers not only technical proficiency but also the ability to use digital technologies consciously, responsibly, and critically. Significant attention is paid to developing reflective attitudes toward the digital environment through courses in digital ethics, media literacy, and digital democracy. Educational institutions, including universities, actively implement programs that train teachers to understand the risks of digitalisation-such as issues of privacy, cybersecurity, and algorithmic bias. At the same time, schools and universities enjoy autonomy in choosing digital strategies, allowing them to adapt educational processes to local needs. Cooperation with industry partners, the creation of digital laboratories, and involving students in real-life cases all contribute to the practical acquisition of digital skills in real-world contexts.

Thus, the Finnish model emphasises trust, freedom of action, and a creative approach to digital learning, whereas the German model prioritises critical thinking, ethical use of technology, and conscious digital participation. Both models demonstrate that the development of teachers' IDC should not be limited to technical aspects but must also be deeply humanistic, taking into account social, ethical, and cultural contexts. The Ukrainian educational system can adapt these approaches, considering national realities, with the goal of forming a sustainable, innovative, and responsible digital culture in schools. Table 1 demonstrates that international and Ukrainian framework documents share a common vision of the multifaceted nature of digital competence (DC).

However, existing empirical data indicated a gap between theoretical understanding and practical application. An important condition for sustainable IDC development is the creation of professional communities of practice that facilitate experience sharing, mentoring support, and the adaptation of newcomers to the digital environment. Equally important is the introduction of IDC assessment tools, including self-assessment instruments and external

monitoring, which help identify needs for professional development and adjust educational strategies accordingly. According to the monitoring results of the State Service for Education Quality of Ukraine (2025), only 39% of teachers create digital learning content, while 47% engage in communication within the digital environment (Table 2).

Table 1. Comparative analysis of digital competence components at the European and Ukrainian national levels

Component	DigCompEdu (EU)	Professional teacher standard (Ukraine)	General IDC components (Ukraine)
Information and media literacy	Information and digital literacy, communication, collaboration	Ability to navigate the information space, search for and critically evaluate information	Skills in identifying sources, selecting, evaluating, and analysing information (Ponomarenko, 2024)
Content creation	Creation of digital content	Ability to effectively use and, when necessary, create new electronic (digital) educational resources	Ability to integrate technologies into teaching, create content (Morze & Kocharian, 2023)
Safety	Safety (including data protection and cybersecurity)	Ability to protect personal data, avoid risks, and respect copyright	Compliance with online safety rules, understanding copyright and information ethics (Diia.Osvita, 2021)
Problem solving and professional development	Problem-solving, lifelong learning	Use of digital services and technologies for professional development	Ability to continuously learn and adapt to new technologies (Naurok, 2025)
Pedagogical approaches	Professional engagement, teaching and assessment, learner empowerment	Use of digital technologies in the educational process, organisation of learning activities	Ability to integrate digital technologies into teaching, design online and blended learning environments (Morze & Kocharian, 2023)

Source: developed by the author

Table 2. Results of monitoring the conditions and use of IT in secondary schools of Kyiv (2024/2025 academic year)

Indicator	Data for 2024/2025 academic year	Changes compared to 2023/2024 academic year
Access to computers for each teacher	88%	Decrease from 98%
Access to multimedia equipment	71%	Decrease from 74%
Free access to the Internet	61%	Increase from 57%
Availability of computers only in the computer science classroom	25%	Increase from 14%
Teachers creating digital content	39%	Not specified
Teachers using technologies for collaboration	59%	Not specified
Teachers communicating in the digital environment	47%	Not specified

Source: developed by author based on State Service for Education Quality of Ukraine (2025)

This creates a contradiction between the high level of readiness and recognition of the importance of innovations and the limited capacity for their practical implementation. To overcome the existing barriers and ensure the sustainable development of digital competence among technology teachers, it is advisable to implement a set of measures. One of them is the establishment of digital hubs in schools – modern, well-equipped spaces for learning, experimentation, and collaboration. In addition, it is necessary to strengthen institutional support, in particular by enhancing the role of the Institute for Digitalisation of Education of the National Academy of Educational Sciences of Ukraine in developing methodological guidelines, educational materials, and organising scientific-practical activities. It is also important to expand international cooperation through participation in joint educational projects, internships, and experience exchanges with European Union countries. Finally, a decisive factor is ensuring adequate funding for the technical modernisation of school infrastructure, which may be provided both from the state budget and through the involvement of private investment. Considering this, the proposed multi-level model for enhancing digital competence is based on the principles of continuity and individualisation, taking into account the current competence level of each teacher (UNESCO, 2023). The model includes three levels:

Level 1: Basic User. Focused on overcoming initial barriers and acquiring fundamental skills such as working with cloud services (Arbook, n.d.). This level represents the starting point in the development of teachers' digital competence, particularly for those who previously lacked systematic experience with digital technologies. The main goal is to overcome initial barriers, which may be both technical and psychological, and to form the basic skills necessary for confident functioning in a digital educational environment. At this stage, teachers become familiar with the basics of working with computers, mobile devices, operating systems, and basic interfaces of educational platforms. Particular attention is paid to mastering cloud services such as Google Workspace, Microsoft 365, Zoom, and Padlet, which enable the creation,

storage, editing, and sharing of learning materials online. According to Arbook (n.d.), access to cloud technologies is a key factor in overcoming digital isolation and expanding opportunities for teachers at the initial stage. In addition to technical skills, teachers acquire the basics of digital safety: creating secure passwords, protecting personal data, and safe online behaviour. This forms a basic level of digital literacy, which serves as a prerequisite for further professional growth. Support at this stage is provided through access to instructional materials, video tutorials, step-by-step guides, as well as mentoring assistance from more experienced colleagues. Such an approach helps reduce anxiety, build confidence, and increase motivation for further learning. In practical terms, teachers begin integrating digital tools into their daily activities: creating electronic lesson plans, conducting online polls, maintaining electronic gradebooks, and communicating with students via educational platforms or messengers. These actions lay the foundation for transitioning to the next level – the functional stage, where digital technologies become an integral part of the teaching methodology.

Level 2: Digital Use. Involves regular and productive use of technologies in teaching, including content creation and organisation of collaboration (Naurok, 2025). At this stage, teachers move from basic mastery of digital tools to their systematic and purposeful use in the educational process. The functional user level implies that digital technologies are no longer an external addition but are integrated into the structure of teaching, methodological activities, and professional communication. Teachers at this stage confidently work with educational platforms such as Google Classroom, Moodle, and Microsoft Teams, and use interactive tools like Kahoot, Mentimeter, Canva, and Genially to create visual content, tests, presentations, and digital teaching materials. They are able to organise distance or blended learning, conduct online lessons, create digital courses, and effectively communicate with students and parents via digital channels.

Particular attention is given to the pedagogical design of digital content – that is, the ability to adapt learning materials to students' age characteristics, lesson objectives, forms of assessment, and technical capabilities. Teachers do not merely use ready-made resources but adapt them, create their own interactive assignments, video tutorials, and electronic portfolios. Moreover, this level implies a conscious approach to digital safety, data privacy, copyright, and the ability to teach students the basics of digital ethics and media literacy. Teachers understand the risks associated with the digital environment and know how to minimise them in the learning process. Professionally, teachers actively participate in digital educational communities, share experiences, complete online courses and certifications, and attend webinars and conferences. This broadens their professional horizons and prepares them for the next stage-the innovative level, where teachers become developers of digital educational products and leaders of digital transformation in schools.

Level 3: Digital Transformation. The highest level, characterised by creative and innovative use of technologies (Naurok, 2025). The innovative level of digital competence development assumes that teachers not only use digital tools in their activities but also create new educational practices, actively implement technological innovations, and act as change agents in the digital transformation of educational institutions. At this stage, teachers or school leaders demonstrate high digital literacy, methodological flexibility, creativity, and the ability for interdisciplinary integration. Teachers at this level design original digital products-interactive courses, educational platforms, mobile applications, digital simulators, and virtual laboratories. They actively apply STEAM approaches, combining science, technology, engineering, arts, and mathematics into a unified educational system. The learning process incorporates AR/VR technologies such as Google Expeditions, Unity, and Metaverse Studio, enabling immersive learning environments and simulation of complex processes in virtual reality.

Beyond technical mastery, teachers at this level possess reflective thinking-the ability to critically assess the impact of digital technologies on the educational environment, the ethics of their use, as well as issues of privacy and digital security. They participate in research activities, develop methodological guidelines, conduct training sessions and workshops for colleagues, speak at conferences, and publish their own findings. Innovative users also actively contribute to building digital culture within educational institutions-initiating the creation of digital hubs, implementing open educational resource policies, forming professional communities of practice, and supporting novice teachers in the process of digital adaptation. Thus, the innovative level is not only an indicator of advanced digital competence but also a marker of leadership, strategic thinking, and readiness to transform the educational environment in line with the challenges of the 21st century.

In the context of educational digital transformation, the strategy on technological innovation in education, proposed by the UNESCO (2021), is particularly relevant. It is based on the principles of continuity and individualisation, which allow for consideration of the initial competence level, professional needs, and motivation of each teacher. For technology teachers and school leaders, this model creates opportunities not only for personal growth but also for strategic management of digital processes within their institutions. For technology teachers, the model envisions a gradual transition from basic digital tool use to the level where the teacher becomes a creator of original digital products, integrates STEAM approaches, employs augmented reality, 3D modelling, cloud services, and elements of artificial intelligence. Importantly, each stage is accompanied by reflection, self-assessment of progress, and the ability to adjust one's educational trajectory. Figure 1 visualises this cyclical progression, illustrating how teachers move through successive stages of digital competence development while continuously reflecting on and adapting their professional practices.

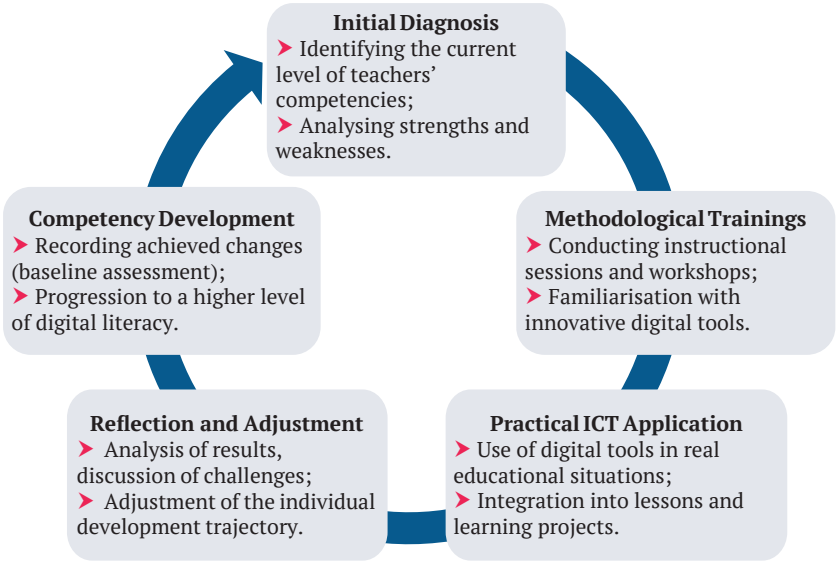

Figure 1. Cyclical model for methodical improvement of teachers' IDC
Source: developed by the author based on UNESCO (2023), O.V. Ovcharuk (2024)

For heads of general secondary education institutions, the multi-level model IDC serves a dual purpose. First, it enables the leader to develop their own digital competence, which is essential for effective management of a modern educational institution. Second, it functions as a tool for strategic planning of the professional development of the teaching staff. The head can initiate the creation of individualised educational trajectories for teachers, organise mentoring programs, implement modular professional development courses, and monitor IDC levels within the internal quality assurance system. Special attention should be paid to the formation of a digital culture within the educational institution. This includes not only technical equipment but also creating an environment where digital tools are used to enhance learning, management, communication, and professional collaboration. Successful implementation of the multi-level model is possible with a combination of institutional support, teacher motivation, and flexible educational formats – such as online platforms, microlearning, certification programs, digital hubs, and professional communities of practice. The multi-level IDC model is not only a tool for individual development but also a foundation for the systematic improvement of digital competence across the entire institution. Its implementation contributes to the creation of a sustainable digital ecosystem capable of adapting to modern challenges and ensuring quality education in the digital era. The improvement of technology teachers' IDC is a multidimensional process that requires a comprehensive approach, combining methodological innovations, institutional support, and a strategic vision for the digital transformation of education.

The conducted study made it possible to identify key trends, challenges, and prospects for the development of IDC among technology teachers in Ukrainian general secondary education institutions. One of the core elements of digital and information competence (DIC) is information and media literacy. It implies the ability to formulate information queries, effectively locate necessary data, and critically evaluate its reliability and relevance. This aligns with the position of A. Ponomarenko (2024), who emphasised that in conditions of information oversaturation it is especially important to teach educators to recognise manipulative technologies, fake information, and adhere to the principles of academic integrity. This idea was also supported by the Ukrainian Institute of Education Development study (UID, 2021), which highlighted the need to develop critical thinking skills as a foundation of information security. T. Berezhna & N. Bessarab (2024), examining the process of forming the information-digital competence of modern educators in the context of implementing the New Ukrainian School Concept, emphasised the necessity of integrating digital technologies into the educational process as a key component of teachers' professional activity. The concept of "information-digital competence", its structure and functional components have been clarified, including technological literacy, the ability to critically process information, and the use of digital resources for learning and communication. The authors underline the importance of creating an information-educational environment that promotes the development of digital culture, enhances the quality of educational services, and fosters new pedagogical practices.

Another important aspect is digital communication and collaboration. N.V. Morze & A.B. Kocharian (2023) defined this competence as the ability to effectively use digital tools for interaction with students, colleagues, and parents. Under these conditions, it should be understood as encompassing the organisation of virtual classrooms, the delivery of online lessons, file sharing, and collaborative work on educational projects. According to the Naurok (2025), digital communication has become an integral

part of the educational process, especially during periods of distance learning. V. Lymarenko (2024) highlighted that digital interaction contributes to shaping an open learning environment, where the teacher acts not only as a source of knowledge but also as a facilitator of learning.

The third component of DIC is digital content creation. This includes the educator's ability to design and implement educational resources in digital form – presentations, video lessons, electronic documents, interactive tests, etc. N.V. Morze & A.B. Kocharian (2023) noted that high-quality digital content increases student motivation and ensures individualisation of the learning process, proving that the use of multimedia materials has a positive impact on knowledge acquisition and the development of students' creative potential. I. Vdovenko *et al*. (2023), studying the development of information-digital competence of vocational education teachers in the context of digitalisation of the educational environment, defined key components of this competence – reflective, technological, methodological, and motivational – and proposed a model for its development. The model includes theoretical and methodological foundations, content-structural components, technological approaches, evaluative-reflective criteria, and organisational-pedagogical conditions. Importantly, through analysis of regulatory documents, international models (including DigCompEdu), surveys, and pedagogical experiments, special attention is paid to adapting European approaches to the Ukrainian context of vocational education. This has practical value for the development of professional development programs, modernisation of educational standards, and implementation of digital technologies in vocational training. Findings by O. Zhukova *et al*. (2021) also highlighted the potential of web-based tasks for strengthening digital competence. Although their study targeted students, the mechanisms they describe – structured work with digital information, creation of online materials, and organisation of interactive digital activities – are directly applicable to teachers' professional practice. These results underscore that integrating well-designed web-based tasks into teaching can enhance educators' ability to use digital tools purposefully and develop pedagogically meaningful digital content.

Another important component is digital safety and ethics. In the context of active use of the Internet and digital technologies, educators must possess knowledge of cybersecurity, personal data protection, and ethical standards for working with information. Diia.Osvita (2021) stressed the importance of fostering a responsible attitude towards the digital environment, emphasising that ethical behaviour online is essential for a safe educational process, especially in conditions of online interaction. The final component to consider is the ability to solve problems and engage in professional development. This competence involves a teacher's readiness for lifelong learning, adapting to new technologies, using digital tools for self-development, and improving professional skills. Diia.Osvita (2021) notes that digital literacy is not only a tool but also a prerequisite for professional mobility. L. Tkachenko *et al*. (2023) pointed out that continuous updating of digital skills allows educators to remain competitive and effective amid the digital transformation of education. These structural components correspond to the categories defined in the European framework for the digital competence of educators (European Commission, n.d.).

Overall, the results of the study demonstrate that IDC of technology teachers is shaped through the interaction of individual, methodological, and institutional factors. Despite the availability of various digital tools and a generally positive attitude towards innovation, teachers still face substantial barriers related to infrastructure, methodological support, and the practical use of digital technologies. At the same time, international experience and the analysed national monitoring data indicate that consistent professional development, access to high-quality digital resources, and participation in professional communities significantly enhance teachers' readiness for digital transformation. Thus, strengthening IDC requires a systemic approach that integrates continuous professional learning, institutional support mechanisms, and a stable digital infrastructure, ensuring not only the development of teachers' skills but also the formation of a sustainable digital culture within educational institutions.

CONCLUSIONS

IDC of technology teachers is a determining factor in their professional effectiveness in the context of educational digital transformation. The conducted study confirmed that IDC levels directly influence the quality of the educational process, teachers' ability to implement innovations, utilise digital resources, and create a modern learning environment. At the same time, identified infrastructure and methodological challenges-such as limited access to digital platforms, fragmented professional development programs, and the lack of systematic IDC monitoring-highlight the need for a comprehensive update of approaches to teacher professional development.

In response to these challenges, a multi-level model for improving IDC has been proposed, combining the principles of continuity, individualisation, and contextual adaptation. The model encompasses a basic level of digital literacy, a functional level of integrating digital tools into learning practices, and an innovative level, which includes STEAM-oriented activities, educational data analytics, and participation in professional communities. This approach allows for the creation of personalised IDC development trajectories, enhances teacher motivation, and ensures quality improvements in the educational process. Promising directions for further research include: the development of a Ukrainian platform for IDC monitoring to ensure data reliability and adaptation of professional development programs; integration of STEAM methodologies into the professional growth of technology teachers; and empirical studies to assess the impact of the proposed

model on student learning outcomes. Implementing these directions will contribute to the formation of a digital culture in general secondary education institutions, improve teaching quality, and foster the innovative potential of the education system.

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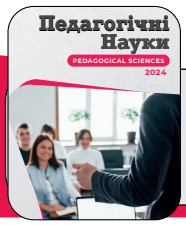
Методичні аспекти вдосконалення інформаційно-цифрової компетентності вчителів технологій навчального закладу загальної середньої освіти

Анотація. Метою дослідження був комплексний аналіз рівня сформованості інформаційно-цифрової компетентності вчителів технологій закладів загальної середньої освіти та обґрунтування методичних підходів до її вдосконалення. У межах дослідження було застосовано методи контент-аналізу наукових джерел, нормативно-правових актів, а також узагальнення результатів національних і міжнародних моніторингових досліджень. Було визначено ключові бар'єри, що стримують розвиток інформаційно-цифрової компетентності вчителів технологій у закладах загальної середньої освіти. Серед них – застаріла матеріально-технічна база, обмежений доступ до сучасного цифрового обладнання та ресурсів, фрагментарне і несистемне підвищення кваліфікації, а також відсутність адаптованих методик оцінювання цифрових навичок. Ці чинники ускладнюють інтеграцію цифрових технологій у навчальний процес, знижують ефективність освітніх практик і гальмують професійне зростання педагогів. Для подолання виявлених проблем запропоновано багаторівневу модель вдосконалення цифрової компетентності. На інституційному рівні вона передбачає створення цифрової стратегії закладу освіти, розвиток внутрішньої підтримки цифрових ініціатив, формування цифрової культури та забезпечення доступу до цифрових ресурсів. Індивідуальний рівень охоплює персоналізовані траєкторії професійного розвитку, врахування мотиваційних чинників, стартового рівня компетентності, доступу до ресурсів, а також впровадження менторських програм і цифрового коучингу. Методичний рівень включає системне впровадження інструментів у навчальний процес, адаптацію навчальних матеріалів до онлайн-форматів, розвиток професійних спільнот практики, формування цифрової педагогіки та підтримку інноваційних освітніх рішень. Практична значущість роботи полягає у формулюванні конкретних рекомендацій для адміністрацій закладів загальної середньої освіти, методичних служб та самих педагогів щодо створення сприятливого освітнього середовища, яке стимулює сталий розвиток цифрових навичок. Запропоновані підходи можуть бути інтегровані в програми підвищення кваліфікації, внутрішні системи оцінювання та стратегічне планування цифрової трансформації освітніх закладів

Ключові слова: DigCompEdu; методичні підходи; професійний розвиток; цифрова трансформація



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Gamification and artificial intelligence in the process of preparing IT specialists for sustainable development challenges

Abstract. The aim of the research was to determine the impact of using gamification and artificial intelligence technologies on the development of professional competencies of future specialists in the field of information technology. The methodology included the analysis of the work of 240 students and lecturers in Ukraine across educational programmes such as Software Engineering, Information Management Systems and Technologies, Computer Science and Technology, content analysis, and the isolation of student task performance results based on a survey to assess the ways of integrating modern digital tools into the educational process. The research examined the use of various digital platforms and tools in the learning process. The results showed that the most popular platform among students is Moodle (40%), followed by Google Classroom (30%), while lecturers prefer Google Classroom (40%) and Moodle (20%). The Kahoot platform scored 10% in both groups, and Repl.it proved to be more appealing to students (5%), while GitHub Classroom was preferred by lecturers (15%). Regarding the frequency of gamification use, lecturers use it daily more often (20%), while no student noted daily use; instead, 40% of students indicated the option "Other", which may suggest irregular or indirect use. On the matter of the convenience of using ChatGPT, 50% of students consider it convenient, but no one rated it as "very convenient", unlike lecturers, among whom 30% expressed this opinion. According to 20% of students, gamification genuinely helps in better memorisation of material, whereas among lecturers only 10% agree, and 45% find it difficult to answer at all. Regarding the impact of artificial intelligence on the quality of learning, both students and lecturers rated it positively equally (20% each), although 40% of students consider it negative, compared to 30% among lecturers. The research findings indicate different approaches of students and lecturers to the use of digital platforms and tools in the educational process, namely Moodle, Google Classroom, and ChatGPT. The research results can be used by lecturers and educational institution administration to improve the educational process by introducing effective forms of gamification and artificial intelligence tools

Keywords: teaching methods; soft skills; digital technologies; motivation; self-directed learning

INTRODUCTION

The relevance of studying and researching the topic of gamification and artificial intelligence (AI) in the process of preparing IT specialists for the challenges of sustainable development is driven by the rapid development of technologies and their impact on various aspects of professional training. Given the fast-paced changes associated with globalisation and the need to ensure sustainable development, it is necessary to investigate how information technologies, in particular gamification and AI, can be integrated into the educational process to improve learning effectiveness and support the adaptation of specialists to new challenges. However, despite the growing attention to these technologies, scientific research in Ukraine and at the international level still does not sufficiently address the integration of gamification and AI in the context of professional training of IT specialists for sustainable

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development, particularly with regard to ethical issues, their impact on student motivation, and adaptation to changes in professional standards (Ministry of Education and Science of Ukraine, n.d.). Thus, it is important to explore the potential of these technologies for the development of flexible and adaptive skills in future professionals.

A large number of authors point to significant interest in the topic of gamification and AI in education, which confirms the relevance and importance of this area for the development of professional training of IT specialists. In particular, A. Azzam & T. Charles (2024) examined the potential of AI in K-12 education, emphasising the importance of early familiarisation of learners with digital technologies, which lays the foundation for the preparation of future IT professionals. They highlighted adaptive learning, intelligent educational systems, and the role of AI in the development of logical thinking, which are essential skills for future IT specialists. In addition, L. Babashahi *et al*. (2024) conducted a systematic review of the impact of AI on the transformation of professional skills in industry, paying particular attention to changing requirements for IT specialists. They found that the labour market increasingly demands specialists who are able to work with big data, understand the principles of algorithm operation, and use digital platforms to manage production processes. The authors emphasised the importance of developing interdisciplinary competences in the IT field. In the study by P. Bitrián *et al.* (2024), the focus was on the application of gamification in staff training, highlighting its effectiveness in developing digital skills, particularly in the areas of information security and data protection, which are key components of IT specialist training. The study showed that interactive learning methods, including gamification, learning simulations, team projects and case-based methods, increase engagement and motivation to acquire IT competences.

A. Capatina *et al*. (2024) examined the impact of gamified approaches on the effectiveness of knowledge acquisition and knowledge transfer in a corporate environment, emphasising the role of such approaches in the professional development system of IT specialists. The authors highlighted that the integration of gamification into internal training contributes to a better understanding of technological processes and the practical mastery of innovative tools, noting that this integration was achieved through the use of point systems, levels, virtual rewards and competitions, which stimulated active participation, immersion in the learning process and the practical adoption of innovative IT tools. L. Carroll (2024) explored five key trends in the development of AI, including task automation, new approaches to productivity enhancement, the ethics of algorithm use, and the expanding role of IT specialists in strategic management processes, all of which directly influence the need for their continuous professional development. M. Cascella *et al*. (2023) investigated the implementation of gamification and AI, as the simulation strategies, AI and digital modelling they describe represent universal tools in the training of IT specialists, particularly in fields requiring precision, adaptability and data analysis. In the work of O.V. Malykhin & T.M. Yarmolchuk (2020), current learning strategies in the professional training of information technology specialists were analysed, with an emphasis on the need to adapt the educational process to the challenges of digital transformation. In particular, the authors substantiated the expediency of integrating information and communication technologies, active learning and the development of critical thinking to enhance the effectiveness of training future IT specialists capable of working in a high-technology environment. O. Patlaichuk *et al*. (2025) studied the effectiveness of gamification and project-based learning as tools for increasing motivation and performance in the professional training of future specialists, particularly in the IT field. The study found that combining practice-oriented methods with game elements, such as badges, leaderboards, real-project scenarios, simulations and quests, contributes to the development of relevant skills, teamwork, initiative and the ability to independently solve complex technological problems.

L. Verbivska & N. Blesko (2024) examined gamification as an innovative approach to learning and enterprise development, particularly in the context of workforce training in the digital era. They substantiated the effectiveness of gamified technologies in developing professional competences, enhancing learning motivation and increasing employee engagement, which is especially relevant for the training of IT specialists and professionals in related fields. However, the above-mentioned studies lacked sufficient data on the impact of gamification on the professional training of IT specialists. The authors also paid insufficient attention to individual differences among learners in their perception of digital learning strategies. The aim of the study was to analyse the effectiveness of using digital technologies, in particular gamification and interactive methods, in the professional training of IT specialists. To achieve this aim, the following objectives were set: to analyse educational programmes for the training of future IT specialists; to identify the impact of gamification and AI on the formation of core knowledge, skills and competences of future IT specialists; and to determine the barriers and pathways for implementing gamification and AI as methods of modernisation in educational programmes for the training of IT specialists.

MATERIALS AND METHODS

The study was conducted in the form of a survey in September 2024 and involved 240 participants aged 17 to 22. The inclusion criteria were enrolment in IT-related specialities at higher education institutions in Ukraine and voluntary consent to participate in the study, while the exclusion criteria included the absence of informed consent and interrupted participation in the survey process. The participants were students of technical specialities from higher education institutions in Ukraine, such as Taras Shevchenko National University of Kyiv, the National

University "Odesa Law Academy", and Kharkiv National University of Radio Electronics. These educational institutions were selected because of their reputation and the availability of highly qualified IT training programmes, which made it possible to ensure diversity and a high level of research among students of technical specialities. In addition, surveys were conducted among both students and lecturers. The study also involved 25 lecturers aged between 29 and 58, which allowed respondents to express their own views and propose ideas for improving the implementation of gamification and AI in the educational process. The survey consisted of five closed-ended questions with predefined answer options. All ethical requirements were observed in accordance with the WMA Declaration of Helsinki (World Medical Association, 2024) and the principles of confidentiality. Participants were provided with clear information about the purpose of the study and confirmed their voluntary participation by signing informed consent forms. The data collected during the surveys were anonymous, and the results were used exclusively for scientific purposes, ensuring the protection of personal information and confidentiality (Table 1).

Table 1. Example of questions that were in the survey

No.	Questions	Answer options
1.	Which type of digital platform do you prefer to use during studies?	➢ Moodle; ➢ Google Classroom; ➢ Kahoot; ➢ Repl.it; ➢ Other.
2.	How often do you use gamification elements in the learning process (tests, quizzes, badges, leaderboards)?	➢ Daily; ➢ Weekly; ➢ Occasionally; ➢ Never.
3.	How convenient is it for you to use artificial intelligence (for example, ChatGPT) for learning?	➢ Very convenient; ➢ Convenient; ➢ Difficult; ➢ Do not use it.
4.	Do game elements (gamification) help you to remember learning material better?	➢ Yes; ➢ Partially; ➢ No; ➢ Difficult to say.
5.	In your opinion, what impact does artificial intelligence have on the quality of your learning?	➢ Positive; ➢ Neutral; ➢ Negative.

Source: compiled by the author

Curricula and educational programmes for bachelor's and master's degrees were analysed, including "Software Engineering" at Taras Shevchenko National University of Kyiv (2021), "Information Management Systems and Technologies" (Osvita.ua, 2025) at National University "Odesa Law Academy", "Computer Science and Technology" at Kharkiv National University of Radio Electronics (2025). The programmes were analysed based on criteria of compliance with the current requirements of IT companies, integration of the latest technologies, in particular AI and gamification, as well as their potential for developing critical thinking and independent work among students.

An experiment was conducted within the study, during which gamification and AI methods were applied to increase the effectiveness of learning. Prior to the experiment, thorough preparation was carried out, including the selection of learning materials adapted to gamification and AI methods. Lecturers completed training in the use of platforms such as Kahoot (n.d.) and Quizizz (n.d.) for interactive tasks and assessment. In addition, learning materials were developed that included interactive lectures and seminars, enabling the effective integration of new technologies into the learning process. Lecturers designed tasks for students using digital tools and gamification elements. In particular, interactive tests were created using GitHub Classroom (n.d.) and Repl.it (n.d.), quizzes were organised via Kahoot, ChatGPT (n.d.) was used to answer typical questions, modular courses were created in Moodle (n.d.), and automated programme testing was integrated into Codewars (n.d.). To analyse the implemented tasks, the content analysis method was applied, which made it possible to systematise the types of tasks, the digital platforms used and the gamification elements. The analysis made it possible to identify the main approaches adopted by lecturers to organising the educational process using digital resources and to reveal prevailing models of interaction with students. During the study, a qualitative comparative analysis of six digital platforms actively used in the educational process was carried out: GitHub Classroom, Repl.it, Kahoot, Moodle, Google Classroom (n.d.) and ChatGPT. Students were assigned tasks involving the completion of interactive tests, programming tasks on the Codewars and Repl.it platforms, participation in quizzes via Kahoot, completion of modular tasks in Moodle, and the use of ChatGPT to formulate answers, which they performed weekly in accordance with the course curriculum.

Student assessment was conducted on the basis of a points-based system. For each task completed on gamification platforms, students were awarded points depending on the speed and accuracy of their responses. For example, for a correct answer in a test or for a successfully completed practical task on a platform, students received between 1 and 10 points. In addition, points were also awarded for participation in discussions and practical classes, depending on students' activity and their ability to solve problems in real time. The overall grade was formed as the sum of points gained across different stages of tasks, taking into account the importance of each stage within the overall context of the course. Recommendations were made for the implementation of gamification.

RESULTS

Characteristics of educational programmes for the training of future IT specialists in Ukraine

Between 2021 and 2025, Ukraine was actively implementing IT education reforms aimed at modernising training programmes for future IT specialists. In particular, the Ministry of Education and Science of Ukraine (2021), together with the Ministry of Digital Transformation, initiated a large-scale reform of IT education, which includes the introduction of new courses on entrepreneurship in the field of information technology in more than 50 universities across the country. In 2023, a pilot project called "Updated IT Studio Computer Science" was launched, which involves updating the content of school computer science with an emphasis on modern technologies such as AI and robotics (Diia.Osvita, n.d.). The advantages of these reforms include close cooperation with the IT business, the introduction of practice-oriented courses, and the opportunity for students to independently choose up to 50% of their academic disciplines, which promotes flexibility and adaptation to the needs of the labour market Ministry of Education and Science of Ukraine (EU4DigitalUA, 2022). However, there are also shortcomings, in particular, a shortage of qualified lecturers with practical experience, outdated elements in the curricula, and insufficient English language skills among students, which complicates their integration into the international IT environment.

In particular, the "Software Engineering" programme at Taras Shevchenko National University of Kyiv (2021) aimed to prepare students to work with big data, AI and machine learning algorithms. The programme included courses where students use AI to solve real-world problems, such as building predictive and data analysis models. The course uses specialised platforms, including Python, TensorFlow, and Keras, allowing students to work with real tools to create AI-based programmes and solutions. These courses also actively use gamification principles, for example, to motivate students to achieve certain levels of task complexity, where points are awarded and certificates are given for each completed task. This promotes healthy competition among students, which in turn increases their motivation to learn. Another programme in "Information Management Systems and Technologies" (Osvita.ua, 2025) at the National University "Odesa Law Academy" also has an important component related to the use of gamification and AI. Students have the opportunity to work on real projects that apply software development methods using AI, particularly in the field of software testing automation. In addition, to consolidate their theoretical knowledge and develop practical skills, students take online courses and interactive seminars that include gamification elements, such as earning points for completing tasks, participating in quizzes, and rankings to encourage better results.

The "Computer Science and Technology" programme at Kharkiv National University of Radio Electronics (2025) provides students with the necessary knowledge to work in the field of data analysis and processing, including the use of AI tools such as automated systems for processing large amounts of data, forecasting models and information management. As part of this programme, students learn the basics of gamification as a method of improving the efficiency of project and business process management, which includes the use of game mechanics to improve user interaction, increase engagement and teamwork efficiency. The programme also involves the integration of AI technologies to automate certain stages of learning, such as interactive tests with automatic answer evaluation and adaptive tasks that change depending on the results of previous stages. Programming using AI and gamification mechanisms allows students to better understand complex technical concepts, teaches them to work with the latest technologies, and prepares them for the real demands of the labour market.

Gamification involves the use of game mechanics in non-gaming contexts, such as education, to increase motivation and engagement among learners, while AI is a branch of computer science that deals with the creation of systems capable of self-learning, data analysis and decision-making, similar to human intelligence. In Ukraine, gamification is being actively implemented in the educational process at the level of schools and higher education institutions, in particular through online platforms, interactive courses and educational applications, while AI is currently developing mainly in the research and start-up environment. However, it is already being used to create adaptive learning systems, automated assessment and analysis of student performance, and both technologies have great potential for integration into the curricula of future IT professionals, especially for personalising learning, increasing student engagement and developing skills that are in demand in the global market. In particular, examples of such programmes demonstrate how innovative teaching methods, such as the use of AI technologies to create adaptive training courses or the introduction of gamification elements to motivate students, can be successfully integrated. The introduction of these technologies makes learning more personalised, adapting it to the individual needs of each student. In addition, it allows for more effective interaction between students and lecturers, thereby

improving the quality of education. Overall, the educational programmes analysed have demonstrated the importance of integrating gamification and AI into the training of modern IT professionals. They make it possible to create a more effective and engaging learning environment that meets the demands of the modern labour market and technological trends. To incorporate gamification and AI into IT specialist training programmes, it is necessary to first update the curricula by adding courses on educational game development and the basics of AI. It is also important to integrate platforms with gamified tasks and AI-based adaptive learning that adjust to the students' level of knowledge. Lecturers need to be trained to work with these technologies, and IT companies should be involved in creating practical case studies and projects. In addition, it is advisable to develop pilot programmes at leading universities to test innovative approaches in real-world conditions.

Assessment of the impact of gamification and AI on the formation of core knowledge, skills and competences of future IT specialists

Information technologies can modernise the educational process, making it more effective and attractive for future IT specialists by increasing student motivation and fostering the development of key professional competences. The purposeful use of gamification and AI through interactive tools such as Kahoot, ChatGPT and Codewars enables the development of students' analytical thinking, self-organisation, technical literacy and teamwork skills. To achieve these outcomes, lecturers' work was organised from the preparation of teaching materials and completion of specialised training to continuous monitoring of learning effectiveness and flexible adaptation of educational content in accordance with students' needs (Table 2).

Table 2. The process of implementing gamification and AI by lecturers in the educational process

No.	Lecturers' activities	Implementation process	Implementation outcomes	Competences developed in students
1.	Creation of interactive tests (GitHub Classroom, Repl.it)	Development of tests with varying levels of difficulty and automated assessment	Increased engagement and rapid feedback	Algorithmic thinking, self-assessment, problem-solving skills
2.	Conducting quizzes via Kahoot	Organisation of real-time games with leaderboards	Growth in student motivation and activity	Teamwork, rapid decision-making, analytical thinking
3.	Use of ChatGPT to answer questions	Provision of answers to typical questions via a chatbot	Time savings for lecturers and improved accessibility of information	Information literacy, self-directed learning, ability to formulate queries
4.	Development of modular courses with gamification (Moodle, Edmodo)	Courses with points awarded for activity, progress bars and rewards	Improved discipline and regular completion of tasks	Self-organisation, time management, strategic planning
5.	Integration of automated testing in Codewars/Replit	Automated assessment of solutions to programming tasks	Individualisation of learning and facilitation of knowledge assessment	Programming skills, attention to detail, ability to work with online resources

Source: compiled by the author

Table 2 presented confirms the effectiveness of integrating gamification and AI into the educational process as innovative methods for training IT specialists at Ukrainian universities. In particular, it demonstrates that the systematic use of modern digital tools such as Kahoot, ChatGPT, Codewars and Moodle contributes to increased student motivation, active engagement in the learning process, and the development of key professional competences. To achieve these outcomes, lecturers' work must be organised in several stages. At the first stage, preparation is required, including completing training on the use of digital platforms, selecting appropriate teaching materials and adapting them to new formats. At the next stage, practical implementation takes place, involving the development and introduction of interactive tasks, automated tests, quizzes and seminars. An important element is also continuous monitoring and feedback: lecturers should analyse task performance results, identify difficulties and promptly adapt course content. Such an organisation of work not only ensures effective assimilation of learning material but also develops students' ability for self-directed learning, critical thinking, working with IT tools and rapid adaptation to the requirements of the digital environment.

The tasks implemented through gamification and AI were oriented towards real skills that students will apply in their professional activities. The tasks should be designed in such a way as to ensure the development of critical competences such as algorithmic thinking, the ability to self-organise, skills in working with various programming tools, and active participation in the learning process. The proposed tasks should be clearly formulated and provide meaningful feedback to students. Students were introduced to programming platforms such as Codewars, where they could practise their skills in real time. For example, the use of platforms such as GitHub Classroom or Repl.it makes it possible to create interactive tests in which students solve specific programming tasks, while automated assessment provides immediate feedback that stimulates the improvement of results. Table 3 demonstrates in detail what specific tasks for students look like when they include elements of gamification and automation, and shows how these tasks help students develop the necessary skills and competences.

Table 3. Examples of tasks for students in the process of implementing gamification and AI in the training of IT specialists

No.	Lecturer's task	Specific example of task implementation
1.	Creation of interactive tests in GitHub Classroom or Repl.it	Task: "Write a Python programme that finds the greatest common divisor of two numbers". During completion, the student must choose a level of difficulty: easy (two numbers up to 100), medium (numbers up to 1,000) or hard (numbers up to 10,000). The test is automatically assessed, and points are awarded for speed and correctness of execution.
2.	Conducting quizzes in Kahoot	Task: "Fundamentals of data structures": 10 multiple-choice questions with three answer options, for example: "What is the time complexity of adding an element to the end of a list in Python?" (A) O(1) (B) O(n) (C) O(log n). Students receive points for correct answers and for the time taken to complete the task.
3.	Using ChatGPT to answer students' questions	Task: The student asks a question via ChatGPT, for example: "Explain the difference between an array and a list in Python". ChatGPT provides a detailed answer with code examples: "Arrays have a fixed size, whereas lists are dynamic." The response includes examples of use in code.
4.	Creating courses in Moodle with gamification elements	Task: Course "Java Fundamentals": after each module, students are offered practical tasks (for example, writing a programme to calculate a factorial), for which points are awarded. Each student receives a badge for successfully completing a particular stage of the course (for example, "Java Syntax Basics").
5.	Integrating automated testing in Codewars or Replit	Task: "Write a function to check whether a string is a palindrome (a word or phrase that reads the same forwards and backwards)." The platform automatically checks the correctness of the code, providing immediate feedback and points for the correctness and optimality of the solution.

Source: compiled by the author

These tasks contribute to the development of the necessary knowledge, skills and competences of future IT specialists, as they are oriented towards the practical application of technologies and the solution of real-world problems, which form the basis of work in the IT sector. Interactive tasks in GitHub Classroom or Repl.it help students develop algorithmic thinking, coding skills and the ability to work with different programming languages. Such tasks stimulate students to solve problems in real time, which is essential for professional activity in the IT environment. Quizzes conducted via Kahoot foster rapid decision-making, attention to detail and logical thinking. These tasks also develop teamwork skills, increase student motivation and engage learners in the educational process through elements of competition. The use of ChatGPT to answer students' questions enhances their capacity for self-directed learning and effective interaction with intelligent systems. Courses on the Moodle platform with gamification elements develop skills of self-organisation and time management. Students learn to complete tasks within a flexible learning framework, gaining opportunities to work on real projects and manage their progress through points and badges. Automated testing on Codewars or Replit enables students to improve their programming skills, develop accuracy and efficiency in code writing, and enhance their ability to adapt quickly to changing conditions. Through these tasks, students not only acquire technical knowledge but also develop critical professional competences such as problem analysis, rapid problem-solving, communication, self-organisation and continuous learning, all of which are integral to the future professional activity of IT specialists. In particular, within the study, lecturers evaluated this process as presented in Table 4.

Table 4. Student results based on completed tasks

No.	Tasks	Number of students	Key assessment characteristics	Assessment results (average score)	Lecturers' comments
1.	Creating interactive tests using GitHub Classroom or Repl.it	240	Use of a scoring system, automatic assessment	7.8 points (average)	Students responded actively, but some of them had difficulty using the interface
2.	Using Kahoot to conduct surveys and quizzes	240	Points for correct answers, extra points for speed	8.2 points (average)	High engagement, but not all students were able to respond quickly during the quiz
3.	Using ChatGPT to answer student questions	240	Automatic provision of answers, saving time	8.5 points (average)	Helped to quickly resolve issues, but the accuracy of responses needs improvement
4.	Using online platforms to create modular courses (Moodle, Edmodo)	240	Points awarded for completed tasks and participation in discussions	7.6 points (average)	Discussions were lively, but not all students actively participated
5.	Integrating automated tests with a programming platform (Codewars, Replit)	240	Assessment of program code, automatic testing of tasks	8.0 points (average)	Automatic testing allowed for a more accurate assessment of students' knowledge levels

Source: compiled by the author

The students' results showed that most of them successfully completed the tasks, receiving average scores ranging from 7.6 to 8.5. Tasks on testing and programming platforms such as Codewars and Replit demonstrated a good level of mastery of the material with scores around 8.0, indicating that the students had a good knowledge of programming. The use of Kahoot for quizzes proved to be very effective in motivating students, with an average score of 8.2, confirming high engagement. The use of ChatGPT yielded the highest scores, but despite this, the accuracy of the answers left something to be desired, which affected the overall result in some cases. Overall, most students performed well on the tasks, but some had difficulty with speed and accuracy when using new technologies. The final survey of lecturers and students was an important step in determining the effectiveness of gamification and AI in the learning process, as shown in Table 5. The results obtained helped not only to assess the current state of the technologies implemented, but also to identify the advantages and difficulties faced by both students and lecturers. This made it possible to develop further ways of integrating these tools into educational programmes, adapting them to the real needs and capabilities of those involved in the educational process.

Table 5. Results of the survey of lecturers and students

Question	Students	Lecturers
What type of digital platform do you like using the most?	Moodle: 40%, Google Classroom: 30%, Kahoot: 10%, Repl.it: 5%, Other: 15%	Google Classroom: 40%, Moodle: 20%, Kahoot: 10%, GitHub Classroom: 15%, Other: 15%
How often do you use gamification elements in the learning process?	Daily: 0%, Weekly: 10%, Occasionally: 20%, Never: 30%, Other: 40%	Daily: 20%, Weekly: 10%, Occasionally: 20%, Never: 30%, Other: 20%
How comfortable are you using artificial intelligence (ChatGPT)?	Very convenient: 0%, Convenient: 50%, Difficult: 30%, Do not use it: 20%	Very convenient: 30%, Convenient: 10%, Do not use it: 25%
Do game elements (gamification) help you better remember the necessary learning material?	Yes: 20%, Partially: 20%, No: 40%, Hard to say: 20%	Yes: 10%, Partially: 10%, No: 35%, Hard to say: 45%
What impact does artificial intelligence have on the quality of learning/activity?	Positive: 20%, Neutral: 20%, Negative: 40%, Do not know: 20%	Positive: 20%, Neutral: 30%, Negative: 30%, Do not know: 20%

Source: compiled by the author

The results of the survey of lecturers and students show a positive attitude towards the use of gamification and AI in the learning process, but also reflect certain problems and challenges. The survey results presented in Table 5 demonstrate the difference in preferences and experience of using digital technologies between students and lecturers. Among students, the most popular platform is Moodle (40%), followed by Google Classroom (30%), while lecturers prefer Google Classroom (40%) and Moodle (20%). The Kahoot platform scored 10% in both groups, while Repl.it proved more attractive to students (5%) and GitHub Classroom to lecturers (15%). In terms of frequency of use, lecturers use gamification more often on a daily basis (20%), while no students reported daily use; instead, 40% of students selected the option "Other", which may indicate irregular or indirect use. When asked about the convenience of using ChatGPT, 50% of students found it convenient, but no one rated it as "very convenient", unlike lecturers, 30% of whom expressed this opinion. According to 20% of students, gamification really helps them remember the material better, while only 10% of lecturers agree, and 45% find it difficult to answer. Regarding the impact of AI on the quality of education, both students and lecturers rated it positively (20% each), although 40% of students consider it negative, compared to 30% of lecturers.

Analysis of barriers and pathways for implementing gamification and AI as methods for modernising educational programmes for the training of IT specialists

The implementation of gamification and AI in educational programmes for training IT specialists at Ukrainian universities is a promising direction for the modernisation of higher education; however, it is accompanied by a number of barriers. One of the main challenges is the technical and financial limitations of universities, in particular the lack of appropriate infrastructure and modern software required to implement gamified platforms or AI-based systems. In addition, there is insufficient awareness and preparedness of teaching staff regarding the effective use of these tools in the educational process, which hinders their widespread adoption. From an organisational perspective, the inertia of educational programmes also poses a significant challenge, as they are difficult to adapt to the dynamic changes in the technology sector due to lengthy bureaucratic procedures for approving and updating curricula. At the same time, positive examples demonstrate the potential of such innovations. For instance, the National University "Lviv Polytechnic" has introduced courses in game application development that include elements of gamification (Pavlyshyn, 2023), while the National Technical University of

Ukraine "Igor Sikorsky Kyiv Polytechnic Institute" (n.d.) is actively developing an AI-based project for the automated analysis of students' responses. These initiatives indicate a growing interest within the academic community; however, large-scale implementation requires comprehensive changes, including state support, the development of an institutional digital culture, and the creation of interdisciplinary teams that combine expertise in pedagogy, programming and AI.

A comparative analysis of modern educational platforms made it possible to outline current trends in the digital learning environment and to identify the most effective tools for different educational tasks. In particular, GitHub Classroom is designed for organising programming assignments with automated code assessment and individual progress tracking, while Repl.it provides a convenient online environment for collaborative work and program testing. Kahoot stands out for its gamified approach to knowledge assessment, which stimulates learner engagement. Moodle, as one of the leading Learning Management Systems (LMS), enables the organisation of a comprehensive educational process, including content delivery, testing and forum-based communication. Google Classroom offers flexible integration with Google services and supports assignment management, communication and assessment. ChatGPT, in turn, functions as a universal digital assistant capable of generating answers, code and explanations, thereby serving as a tool for personalised learning. Most of these platforms are available free of charge with certain functional limitations, whereas Moodle requires technical maintenance in the case of self-hosting.

An analysis of interfaces and functional capabilities showed that Google Classroom and Repl.it are the most user-friendly due to their intuitive design. Kahoot attracts users with its gamified interaction format, while GitHub Classroom requires a certain level of technical competence. Moodle, although functionally rich, is complex to configure for inexperienced users. ChatGPT is distinguished by its ease of use and flexibility of interaction. In terms of learning analytics and performance monitoring, Moodle, Google Classroom and GitHub Classroom provide extensive analytical tools, whereas Kahoot offers only test reports and Repl.it provides basic progress tracking. Overall, Google Classroom and Moodle are the most universal platforms for organising the general educational process; GitHub Classroom and Repl.it are optimal for programming courses; Kahoot is effective for interactive assessment; and ChatGPT is well suited for individualised learning support. Thus, the effective use of educational technologies lies in their rational combination according to specific pedagogical objectives.

It is also worth paying attention to the edX platform, which was created in collaboration with leading universities and companies such as Harvard and MIT. EdX offers free courses on topics such as AI, machine learning, big data analysis, robotics, and cybersecurity. All courses have a clearly defined structure and include both theoretical materials and practical tasks, allowing students not only to gain new knowledge but also to gain practical experience in solving specific technical problems. Programmes on edX also include gamification elements such as points, badges, and certificates, which increase student motivation and allow them to evaluate their achievements.

Given the importance of self-education in the modern world, great attention should be paid to programmes that allow students to independently choose topics for study and take courses at a convenient time and place. One such platform is Udacity, which specialises in courses for developing IT skills. Students can choose specialisations such as Data Science, AI, Web Development, and Cloud Computing. A distinctive feature of Udacity is the availability of project work, where students create real products that are then evaluated not only by lecturers but also by employers. This approach allows students to work on real-world problems while still in school, which is an important aspect of preparing for a future career. Another progressive platform for self-study is Khan Academy, which offers open online courses in mathematics, programming, physics, and other disciplines. A distinctive feature of this platform is the use of gamification through a system of points and achievements, which makes the learning process more interesting and motivating for students. For IT students, an important aspect is the availability of interactive exercises and tasks that allow to practise programming and other technical skills.

Other modern platforms for developing the skills of IT specialists are also actively used in foreign practice, in particular LeetCode, which specialises in tasks involving algorithms and data structures. This platform allows students to practise solving real technical problems, which can be useful when preparing for interviews at IT companies. HackerRank is another platform that allows students to improve their programming skills through a series of practical tasks. When it comes to tools for implementing AI in the learning process, one of the most advanced approaches is to use programmes such as TensorFlow and PyTorch. They allow students to learn the basics of machine learning and AI, create neural network models, and test them in real-world conditions. Lecturers can use these tools to conduct practical classes where students independently build and configure models. Universities are actively integrating such platforms into their educational programmes, giving students the opportunity to work with real data and gain practical experience in solving complex problems. For example, universities such as Stanford University and MIT actively use Google Colab to create and test machine learning models (Lee, 2024). They also use integration with GitHub, which allows students to work on collaborative projects and receive feedback from lecturers and classmates.

In modern educational practice, digital platforms and tools that promote the development of IT skills in students are being actively implemented. Platforms such as LeetCode and HackerRank enable students to develop programming skills by solving practical problems, which is useful when preparing for technical interviews. Tools for implementing AI in the learning process, such as TensorFlow

and PyTorch, allow students to learn the basics of machine learning and create neural network models. Universities, including Stanford University and MIT, actively use Google Colab to create and test machine learning models, as well as integration with GitHub for collaborative work on projects. These approaches help students develop practical skills and prepare them for real-world challenges in the IT field.

DISCUSSION

The results showed that combining gamification and AI helped IT specialists develop the meta-skills needed to respond to sustainable development challenges. It was found that the integration of game mechanics with AI technologies stimulated not only cognitive but also emotional engagement of students, increasing their motivation, self-organisation, adaptability and ability to interact across disciplines. These results confirmed the importance of a comprehensive approach to training specialists, focused on future global changes, in particular – digitalisation, environmental transformation and the need for innovative teaching methods. These results were consistent with the study by J.R.G. Niño *et al*. (2025), which emphasised that the use of a gamified approach in combination with AI is an effective tool for developing 21st-century skills such as critical thinking, teamwork and digital literacy. Similar conclusions were found in the work of V.I. Pardim *et al*. (2025), which found that the use of the ThinkBox gamified environment with AI elements significantly improved student engagement in the learning process and fostered a proactive attitude towards solving real-world problems.

The results of the study also indicated positive dynamics in the emotional sphere of students who participated in learning using gamification and AI. In particular, there was a decrease in anxiety levels, an increase in emotional stability, and an increase in self-confidence. Such emotional support in the educational process is an important condition for the formation of a healthy psychological climate in the academic environment, which, in turn, has a positive effect on academic performance and overall satisfaction with learning. These results are consistent with the findings of B.-J. Kim & J. Lee (2024), who argued that the use of AI in teaching practices contributes to the creation of a more personalised environment in which students feel more secure and emotionally supported. A study by G. Koman *et al*. (2024) found that gamified educational platforms with adaptive AI algorithms allow for the individual characteristics of students to be taken into account, which reduces their frustration and increases their satisfaction with learning. A study by S. Rana & R. Chicone (2025) also confirms that the integration of AI into the educational process contributes to the development of students' stress resistance, as it allows them to learn at their own pace in a safe and controlled environment.

A significant finding in this research was the discovery of the impact of AI not only on the emotional state but also on the formation of students' environmental awareness. Participation in simulation game scenarios, based on sustainable development models, allowed students to immerse themselves in the issues of climate change, resource depletion, and social responsibility. This format of presenting information not only promotes the acquisition of environmental knowledge but also fosters empathy for global problems and motivation to take action. Partial confirmation of these conclusions can be found in the work of E. Mitsea *et al*. (2025), where the authors emphasised the effectiveness of so-called "serious games" in the development of meta-skills, in particular environmental responsibility, social and digital ethics. At the same time, the analysis also revealed certain shortcomings: students tended to uncritically accept information presented in a game or visualised format. Students were often more fascinated by the game process than by the knowledge itself, which in some cases led to a superficial understanding of complex concepts. This coincides with the conclusions of Y. Walter (2024), who drew attention to the need to develop AI literacy among students. The researcher emphasised that excessive enthusiasm for gamification without proper analytical thinking can lead to the formation of a distorted view of reality, which is especially dangerous in the context of information overload. Thus, the integration of gamification and AI does have a powerful positive effect on students' emotional state and the formation of key social and ethical attitudes. However, in order to achieve a balanced result, it is necessary to complement these tools with the development of critical thinking and digital literacy, which will help to avoid the potential risks of simplified or manipulative perception of information.

Another important aspect was the development of skills for adapting to an interdisciplinary environment. The analysis showed that students who studied in a gamified environment with AI support were better oriented in related fields (ecology, engineering, social sciences), which confirmed the need for flexible educational trajectories. These findings coincided with the ideas of K.K. Ramachandran *et al*. (2024), who pointed out that personalised AI-based training platforms are key to reskilling and upskilling employees in times of rapid change. Despite the positive aspects, the study results also revealed potential risks. In particular, there was a tendency towards a decline in critical analysis and autonomy among students in an environment where AI made too many decisions. This was consistent with the views of N. Cavus *et al*. (2023), A. Deroncele-Acosta *et al*. (2024) and S. Pink *et al*. (2025), who considered the issue of trust in AI to be one of the main ethical dilemmas in the professional environment. A similar problem was identified by J. Li *et al*. (2024), who found that over-reliance on AI reduced decision-making activity among UX designers. The results also confirmed that gamification using AI effectively developed soft skills, communication skills, creativity and self-management abilities. This was consistent with the research of B.C. Surve & A.P. Ghatule (2024), who pointed to a significant increase in the

individualised approach to learning thanks to adaptive AI algorithms. Similar trends were also reflected in the work of N. Tusquellas *et al*. (2024), which proved that AI can act as a catalyst for professional development when combined with gamified practices. However, certain aspects of the study differed from the results of some previous works. For example, the study by S.A. Santos *et al*. (2021) emphasised that the effectiveness of gamification in professional learning depends on the specifics of the content and the role of the facilitator. In the context of the study, it was found that even without significant teacher involvement, an autonomous learning system with AI elements in a game format demonstrated a high level of student engagement. This indicated a possible transformation of the teacher's role in the future from instructor to moderator or mentor. Some controversial conclusions were also observed in the topic of the impact of AI on ethical awareness.

Studies by B. Gutiérrez-Caneda *et al*. (2024) and D. Tolks *et al*. (2024) raised the question of whether automated decisions could negate the ethical dilemmas necessary for the formation of sustainable practices. However, the study found that gamification with real-life simulations forced students to make morally sound decisions, thereby strengthening social responsibility. Data related to preparing students for changes in the professional sphere deserved special attention. It was found that participants in AI-based gamification training showed a higher level of readiness for technological challenges, which was confirmed by similar findings by A.B. Rashid & A.K. Kausik (2024) and B.Z. Poljašević *et al*. (2024), who analysed the transformation of industrial sectors under the influence of AI. Additional support for this was provided by the study by J. Zhang & S.H. Fenton (2024), which indicated that preparation for the AI future should include not only technical skills, but also the ability to learn throughout life, which was actively cultivated in the studied training model. The role of multimodality in gamified environments is also worth noting. According to F.J.J. Reis *et al.* (2024), it was multisensory and immersive technologies that shaped higher engagement and emotional memory in learning participants. The study confirmed this observation: additional visual, audio, and interactive effects supported by AI contributed to a deeper understanding of complex concepts of sustainable development. It is also worth noting that the results coincided with the analytical conclusions of A. Torres-Toukoumidis *et al*. (2024), who analysed the scientific literature and found that the combination of gamification and AI enhances the learning effect, especially in the context of the digital transformation of education. In general, the combination of gamification and AI in the educational process not only contributes to the development of technical skills, but also shapes ethical awareness, social responsibility and students' readiness for the challenges of sustainable development.

CONCLUSIONS

The research aim correlates with the results obtained: it was found that traditional educational programmes in Ukrainian higher education institutions had limited interactivity and hardly used innovative approaches, which negatively affected student motivation. As a result, the approbation of gamified platforms and AI tools proved its viability as a means of increasing student engagement, activating the learning process, and developing the necessary professional competencies.

The study confirmed that the use of gamification and AI cultivated knowledge of algorithmic thinking, the ability to work with digital platforms, solve problems in real-time, and developed competencies such as digital literacy, teamwork, adaptability, and self-directed learning in students. Specifically, 240 students participated in the study, and the results showed that 40% of students chose Moodle as the most convenient learning platform, 30% preferred Google Classroom, 15% selected other platforms, and 10% preferred to use Kahoot. Regarding gamification elements, 40% of students indicated that they use them sometimes, 20% – weekly, and 30% do not use them at all. 50% of students noted that AI (e.g., ChatGPT) is convenient in the learning process, but 30% pointed to difficulties in its use. When it came to the influence of gaming elements on memorisation of learning material, 40% of students responded that it does not help, 20% – that it partially helps, and only 20% noted that gaming elements significantly facilitate memorisation. Regarding the influence of AI on the quality of learning, 40% of students indicated a neutral impact, 20% considered the impact positive, and another 20% – negative. The research results showed that the implementation of modern technologies into the educational process is possible through updating curricula, training lecturers, and integrating digital platforms. The prospects for further research lie in the development of innovative educational models that integrate gamification and AI to prepare IT specialists for addressing sustainable development challenges, particularly through the implementation of adaptive learning, intelligent decision support systems, and big data analysis within the context of the United Nations Sustainable Development Goals.

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Ґейміфікація та штучний інтелект в процесі підготовки ІТ-фахівців до викликів сталого розвитку

Анотація. Метою дослідження було визначення впливу використання ґейміфікації та технологій штучного інтелекту на розвиток професійних компетентностей майбутніх фахівців сфери інформаційних технологій. Методологія включала аналіз роботи 240 студентів і викладачів в Україні за такими освітніми програмами, як Software Engineering, Information Management Systems and Technologies, Computer Science and Technology, контент-аналіз та виокремлення результатів виконання завдань студентами на основі опитування з метою оцінки шляхів інтеграції сучасних цифрових інструментів у навчальний процес. У дослідженні було вивчено використання різних цифрових платформ та інструментів у навчальному процесі. Результати показали, що серед студентів найбільш популярною платформою є Moodle (40 %), за нею – Google Classroom (30 %), тоді як викладачі віддають перевагу Google Classroom (40 %) та Moodle (20 %). Платформа Kahoot набрала по 10 % в обох групах, а Repl.it виявилася більш привабливою для студентів (5 %), тоді як GitHub Classroom – для викладачів (15 %). У частоті використання ґейміфікації викладачі частіше використовують її щодня (20 %), тоді як жоден студент не відзначив щоденне використання; натомість 40 % студентів вказали варіант "Інше", що може свідчити про нерегулярне або непряме використання. У питанні зручності застосування ChatGPT 50 % студентів вважають його зручним, але ніхто не оцінив його як "дуже зручний", на відміну від викладачів, серед яких 30 % висловили таку думку. Ґейміфікація, за словами 20 % студентів, справді допомагає краще запам'ятовувати матеріал, тоді як серед викладачів таких лише 10 %, і 45 % взагалі важко дати відповідь. Щодо впливу штучного інтелекту на якість навчання, і студенти, і викладачі однаково оцінили його позитивно (по 20 %), хоча серед студентів 40 % вважають його негативним, у порівнянні з 30% серед викладачів. Результати дослідження свідчать про різні підходи студентів і викладачів до використання цифрових платформ та інструментів у навчальному процесі, а саме Moodle, Google Classroom; ChatGPT. Результати дослідження можуть бути використані викладачами та адміністрацією навчальних закладів для вдосконалення освітнього процесу шляхом впровадження ефективних форм ґейміфікації та інструментів штучного інтелекту

Ключові слова: методи навчання; гнучкі навички; цифрові технології; мотивація; самонавчання

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Formation of cross-cutting skills in primary school pupils within extracurricular educational institutions

Abstract. Transversal skills are considered a key component in the development of the younger generation, which is confirmed by the provisions of international documents and national educational reforms in Ukraine. The need to form transversal skills in Ukrainian primary school pupils has become particularly relevant in the context of Ukraine's integration into the European educational space. The aim of the study was to determine the criteria for assessing transversal skills of primary school pupils on the example of the Municipal Institution – Centre for Out-of-School Work of the Putyvl City Council and Konotop Lyceum No. 7 named after Hryhorii Hulianytskyi of the Konotop City Council of Sumy Region, and to analyse the results of monitoring the formation. The study applied a comprehensive methodological approach combining analysis of scientific sources, empirical study of the formation of transversal skills in primary school pupils and expert assessment of the level of these skills in pupils by teachers. Based on the analysis of scientific literature, the essence of the concept of "transversal skills" in the context of developing key competences of primary school pupils was clarified, and the importance of out-of-school education for forming these skills and the ability of primary school pupils to apply knowledge in practical situations was substantiated. On the basis of the results of the expert evaluation method conducted among primary school teachers and educators, the following five main criteria for assessing transversal skills of primary education pupils were determined: creativity, social and emotional development, communicative competence, critical thinking and application of knowledge in real-life situations. Examples of pedagogical practices that contribute to the formation of these skills were presented, as well as the conditions under which these practices are most effective for the development of primary school pupils were outlined. The study emphasised the importance of out-of-school education as a space for developing the competent personality of the primary school pupil. The practical significance of the study lies in the possibility of using the results by teachers of out-of-school educational institutions and primary school teachers for the further development of transversal skills of primary school pupils in out-of-school educational institutions

Keywords: creativity; critical thinking; out-of-school education; social and emotional development; digital literacy

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INTRODUCTION

In the 21st century, the reorientation of Ukrainian education towards European standards requires systemic reforms aimed at updating the content, technologies, and approaches to learning. At the same time, the process of modernisation is taking place under conditions of challenges specific to Ukraine: the spread of distance learning, frequent power outages and security threats associated with the full-scale invasion of russia into Ukraine, which has continued since 2022. Such circumstances affect the work of teachers and pupils and increase the need for flexible, change-resilient educational solutions. As tools and technologies rapidly become obsolete, these technologies and instruments must be regularly updated, and effective methods sought that ensure the modernity of the educational environment, especially in primary school. Innovations in education are aimed at solving current problems by means of new, simple and effective approaches that improve the quality of learning.

The relevance of the outlined issues is also confirmed by the results of contemporary scientific research focusing on the development of transversal skills in primary school age, in particular in the works of N. Hrona *et al.* (2022) and O. Bilous (2025). In the works, the authors emphasised that the formation of such skills contributes not only to academic achievements but also to the development of the personality of the primary education pupil as an active participant in the sociocultural environment. Another group of Ukrainian scholars, in particular N. Yevtushenko *et al.* (2023), studied the impact of artificial intelligence on the development of pupils' "soft" skills. The researchers noted that artificial intelligence assistants improved the educational process, as these assistants provided teachers with information necessary for close and empathetic work with pupils, which in turn made it possible to develop such skills in pupils. The study stressed that the use of artificial intelligence technologies allows the teacher to maintain contact with pupils and helps to control important decisions, which develops decision-making skills and is important for risk management.

At the same time, modern academic discourse highlights the need to go beyond the assessment of pupils' cognitive abilities alone. Thus, S. Joksimovic *et al.* (2020) emphasised that an effective educational process must take into account social and emotional, communicative and metacognitive aspects of learning alongside academic outcomes. This approach is consistent with the concept of transversal skills, which are formed as a complex of cognitive, social and personal characteristics of the pupil.

In addition, academic studies separately stress the need to take into account the specific social and security conditions under which the Ukrainian education system currently operates. For example, I. Kostikova & T. Viedier-nikova (2023) emphasised the need to develop transversal skills of pupils in Ukrainian schools under conditions of full-scale war and martial law (frequent blackouts, the need often to go down to shelters, the need to be psychologically prepared for learning in different conditions). Under these conditions, pedagogical approaches capable of ensuring pupils' adaptability, emotional resilience and engagement acquire particular importance, including play-based activities, integrated learning and artistic practices. Practising teachers emphasised that it is the practical focus of education that ensures its real-life value.

The problem of forming transversal skills in primary school age is the focus of attention not only of Ukrainian but also of foreign scholars. Studies by contemporary foreign researchers confirm that the development of critical thinking begins in primary school age, especially under conditions of problem-based learning. Scholars from Hong Kong C.I. Chau *et al.* (2019) considered gamification as a means of developing flexible skills of primary school pupils and studied its impact on pupils' psychological development. A. Han *et al.* (2021) demonstrated the importance of teamwork for the development of soft skills in primary school pupils. American researchers K.L. Kaspar & S.L. Massey (2023) identified a link between the introduction of social and emotional learning and the development of pupils' transversal skills. The researchers identified potential problems and developed general recommendations for school leaders to take into account the specific features of implementing social and emotional learning in primary schools, in which the researchers set out a step-by-step plan of action that can be used as guidance for developing skills of constructive management of one's own emotions.

The formation of transversal skills is impossible without the development of social and emotional intelligence. In this context, the social and emotional component of the development of the primary school pupil's personality acquires particular importance. Academic studies by W. Birhan *et al*. (2021) and M. Alzahrani *et al*. (2019) confirmed the need to develop social and emotional competence for pupils' behaviour, which in turn influenced the educational achievements of primary school pupils. CASEL's SEL Framework (2020) programme proved that the development of social and emotional skills in school and out-of-school learning improves academic outcomes and has a positive effect on the further development of the personality. The "Philosophy for Children" method (Lipman, 1976), as well as newer OECD (2021) recommendations, underline the importance of developing critical thinking as one of the key skills of the twenty-first century. According to the World Economic Forum (2024) report, creativity is one of the five key skills needed in the future world of work. Out-of-school institutions, with the focus on developing individual abilities, play a leading role in forming this competence. In addition, practising teachers stressed the need for a well-founded assessment of the skills under study, as well as for the development of innovative methods for forming and developing transversal skills.

However, despite the considerable number of works devoted to defining the essence and list of transversal

skills, modern scientific and regulatory literature lacks clear and validated criteria for the assessment in primary school pupils. Existing classifications describe the content of skills but do not provide tools for measuring the level of the formation. This complicates the monitoring and comparison of educational outcomes in different learning conditions, particularly in out-of-school activities. In this regard, there is a need to develop criteria that will make it possible objectively to assess the level of formation of transversal skills and to ensure a thorough empirical study of this process. Taking this into account, the aim of this work was to determine criteria for assessing transversal skills of primary school pupils and to analyse the formation of these skills in primary school pupils on the example of the Municipal Institution – Centre for Out-of-School Work of the Putyvl City Council and Konotop Lyceum No. 7 named after Hryhorii Hulianytskyi of the Konotop City Council of Sumy Region on the basis of the developed criteria. To achieve this aim, the following intermediate tasks were implemented step by step: 1) to determine the criteria and levels for assessing transversal skills of primary school pupils; 2) to clarify the current state of development of soft skills of primary school pupils; 3) to analyse the results of the study conducted.

MATERIALS AND METHODS

At the first stage of the study, materials were prepared and the pedagogical experiment was organised. During this period, scientific literature on the research problem was analysed, the programme of the pedagogical experiment was developed, and diagnostic tools were selected and designed (questionnaires, tests, surveys, result-recording sheets). Criteria and indicators for assessing the level of formation of transversal skills of primary school pupils were also defined. The experimental programme was developed and based on an interdisciplinary approach as one of the key trends in modern education, which presupposes consideration of educational phenomena in an integral interrelationship rather than in isolation.

The empirical stage of the study directly envisaged the implementation of the developed programme in the educational process, with subsequent analysis of the results obtained. This stage was implemented in two interrelated substages – classroom and extracurricular – which made it possible comprehensively to assess the formation of transversal skills of primary school pupils in different educational contexts. The empirical study was conducted at the Municipal Institution – Centre for Out-of-School Work of the Putyvl City Council and Konotop Lyceum No. 7 named after Hryhorii Hulianytskyi of the Konotop City Council of Sumy Region. It covered 84 primary school pupils aged 6 to 11 of both cycles of primary school: the adaptation-and-play cycle (56 pupils) and the subject-based cycle (28 pupils). Pedagogical observation was applied as a transversal method throughout the entire empirical stage, which made it possible to trace the dynamics of the manifestation of pupils' communicative, cognitive, creative and organisational skills in the course of various types of educational and extracurricular activities.

Within the classroom substage, specially designed tasks and exercises were carried out, aimed at diagnosing communicative skills, the ability to work in a team, critical thinking, creativity, emotional intelligence and self-organisation. The level of communicative skills was determined using the exercises "Continue the Story" and "Describe the Picture". Group projects were used to test teamwork skills. To assess critical thinking, the exercises "What Will Happen If…?" and "Justify Your Answer" were conducted. Creativity was checked using the exercises "Create Your Own Fairy Tale" and "Finish the Story"; emotional intelligence was tested through the description of emotional pictures and the exercise "How Does the Character Feel?"; the tasks "Plan of the Day" and self-assessment helped determine pupils' skills of self-organisation and responsibility.

Within the extracurricular substage, the development of pupils' transversal skills took place in a blended learning format and covered children's participation in the activities of out-of-school educational institutions and various forms of extracurricular activity. Pupils were involved in clubs, including introductory technical modelling, vytynanka (paper cutting), dancing, woodwork, nature study, as well as in the activities of sports sections, volunteering campaigns and group creative projects. In the course of the work, virtual excursions were held, pupils were involved in creating simple presentations and using educational platforms. In out-of-school educational institutions, the interdisciplinary approach was implemented through the integration of knowledge from natural sciences, technical, humanities, and arts fields. In particular, during classes in robotics clubs, elements of physics, computer science, mathematics, design, and engineering were combined, which contributed to forming pupils' ability to solve problems in a complex way, to work with different sources of information, to analyse it and to establish cross-curricular connections. In parallel, data were collected from primary school teachers, who assessed the level of pupils' transversal skills on a scale from 1 to 11, where the lower boundary (1) meant the lowest level and the higher (11) the highest. The sample included 8 educators, among whom there were 3 primary school teachers and 5 club leaders working with primary school pupils. All participants had more than 10 years of teaching experience, which was the basis for the involvement as experts.

The final stage of the study involved the analysis of primary school pupils' work and the summarising of the results of teachers' questionnaires. For the purpose of primary evaluation of the sample, methods of descriptive statistics were applied; for the analysis of the results of questionnaires and observations, methods of qualitative analysis were used. In the course of mathematical calculations, methods of data processing and analysis via Excel were applied. To ensure a holistic view of the process of development of primary school pupils, a comprehensive approach was used, which envisaged pedagogical

substantiation of criteria on the basis of modern scientific literature, generalisation of practical experience and determination of levels of formation of transversal skills. The study was conducted in a confidential mode in compliance with ethical norms within extracurricular activities held at the above-mentioned schools and out-of-school educational institutions (World Medical Association, 2024).

RESULTS AND DISCUSSION

The current Ukrainian document emphasises the need to prepare learners for real-life situations. Therefore, the competence-based approach to learning was defined as one of the leading ideas of the reform by the Ministry of Education and Science of Ukraine (2016), since it is aimed at forming in pupils not only basic competences but also transversal skills necessary for successful socialisation and adaptation of primary school pupils to the rapidly changing conditions of the modern world. According to the Law of Ukraine No. 38-39 (2017), such skills include: (1) the ability to read with understanding and to express one's own opinion in oral and written form; (2) the ability to think critically and systematically and to justify one's own position logically; (3) the ability to act creatively; (4) the ability to show initiative; (5) the ability to manage emotions constructively; (6) the ability to assess risks; (7) the ability to make decisions; (8) he ability to solve problems; (9) the ability to cooperate with other people. These skills form the list of basic competences defined in the current State Standard of Primary Education (Resolution of the Cabinet of Ministers of Ukraine No. 87, 2018), in which attention is focused on the formation of transversal skills in accordance with the recommendations of international educational organisations, in particular OECD (2021).

On the basis of scientific literature and the method of expert evaluation, criteria were established for assessing transversal skills of primary education pupils, which took into account not only the results of educational activity of primary school pupils but also the out-of-school experience while attending clubs, implementing projects and interacting with peers and adults. These criteria ensured a holistic understanding of the levels of competence formation and created conditions for the individual educational trajectory of each pupil. However, during 2020-2025 the list of transversal skills underwent certain changes, and the most relevant skills were defined as follows: (1) analytical thinking and innovation, (2) active learning and learning strategies, complex problem-solving, critical thinking and analysis, creativity, originality and initiative, leadership and social influence, use of technology, monitoring and control, technology design and programming, resilience, stress tolerance and flexibility, logical reasoning, problem-solving and ideation (Resolution of the Cabinet of Ministers of Ukraine No. 87, 2018). The foundation of these skills is laid in primary school, and the purposeful formation requires a scientifically grounded system of criteria and indicators of assessment. The assessment of transversal skills should be based on a comprehensive approach, taking into account not only the results of educational activities but also the out-of-school experience of primary school pupils, which is formed in the process of interaction with peers and adults, for example, during project activities and attendance of clubs of various types.

The European competence framework LifeComp (Sala *et al*., 2020) aimed at the formation and development of nine skills organised into three domains: personal, social and cognitive, which distributes ten "soft skills" into the following groups: cognitive, interpersonal and intrapersonal. In the Ukrainian educational space (Linnik *et al*., 2022), slightly different transversal skills were defined; however, these skills can also be distributed among the three main domains described in the aforementioned works. Based on the results of the theoretical analysis in this study, a classification of transversal skills of primary school pupils by domains was carried out, which is presented in Table 1.

Table 1. Distribution of transversal skills of primary school pupils by domains

Domains	Transversal skills
Personal	Ability to act creatively
	Ability to manage emotions constructively
Social	Ability to cooperate with other people
	Ability to show initiative
Cognitive	Ability to read with understanding
	Ability to express one's own opinion in oral and written form
	Ability to think critically and systematically
	Ability to justify one's own position logically
	Ability to assess risks
	Ability to make decisions
	Ability to solve problems

Source: developed by the authors on the basis of studies by O.O. Linnik *et al*. (2022)

The analysis of the data presented in Table 1 shows an uneven distribution of transversal skills across the domains. The predominance of skills in the cognitive domain indicates that modern primary education is oriented towards the development of cognitive and learning skills. At the same time, the relatively lower representation of the social and personal domains proves the need for the purposeful development, particularly in

the context of out-of-school activities, where broader opportunities are created for the formation of social, emotional and creative skills. On the basis of the analysis of scientific literature, a classification of transversal skills of primary school pupils by domains was carried out, which is presented in Table 2.

Table 2. Distribution of transversal skills of primary school pupils by criteria

Transversal skills	Criterion
Ability to act creatively	Creativity
Ability to manage emotions constructively	Social and emotional development
Ability to show initiative	
Ability to cooperate with other people	Communicative competence
Ability to express one's own opinion in oral and written form	
Ability to read with understanding	Critical thinking
Ability to think critically and systematically	
Ability to justify one's own position logically	
Ability to assess risks	Application of knowledge in real-life situations
Ability to make decisions	
Ability to solve problems	

Source: developed by the authors

The data presented in Table 2 indicate an uneven distribution of transversal skills according to the defined criteria. The largest number of indicators falls under the criteria of critical thinking and application of knowledge in real-life situations, which points to the complex nature and leading role in the formation of competences of primary school pupils. At the same time, the criterion of creativity is represented by only one indicator, which may indicate its narrower focus within this study. The obtained results also show that the manifestation of transversal skills depends on the educational environment: in out-of-school activities pupils more often demonstrate initiative, cooperation, and the application of knowledge in practical situations, whereas in school learning the skills related to reading, analysis of information and argumentation prevail. Additional data regarding the level of formation of the specified skills were obtained during the analysis of essays, presentations, projects, and the performance of creative and competence-based tasks.

To substantiate the content of the defined criteria and the use in further analysis, it is advisable briefly to characterise each criterion from the standpoint of modern pedagogical approaches. The creativity of primary school pupils is manifested in the ability to generate new ideas and combine non-standard solutions. In the out-of-school environment, creativity is developed during club activities: drawing, robotics, music and so on. Levels of formation were determined by such indicators as the number and variety of ideas, the pupil's ability to improve ideas and readiness to experiment. As creativity presupposes the ability to find new solutions, to generate original ideas and to implement these ideas in practice, during the pedagogical experiment in art clubs, drama studios and music ensembles, primary school pupils obtained the opportunity to reveal the potential and learn to think in a non-standard way. Creativity is closely related to other transversal skills: critical thinking, cooperation and digital literacy. For example, the creation of multimedia projects requires not only technical knowledge but also a creative approach.

The criterion of pupils' social and emotional development covers the ability of primary school pupils to be aware of the emotions, to empathise with others and to overcome conflict situations. Such skills directly influence academic success and adaptation in society. In out-of-school activities (for example, when participating in children's camps, role-playing games and volunteering initiatives) pupils learn compassion and emotional regulation. The indicators were the pupils' ability to identify the feelings, to react adequately to the emotions of others and to resolve conflicts in a non-violent way. Primary school pupils are at the stage of active formation of the emotional sphere, and it is precisely out-of-school education that creates a favourable environment for the development of such qualities as empathy, the ability to self-regulate and the ability to work in a team. During out-of-school activities, primary school pupils took part in collective games, projects and creative performances, which contributed to the formation of emotional resilience and the ability to resolve conflicts. This, in turn, ensured the development of critical thinking, as primary school pupils learn to evaluate situations not only from the standpoint but also taking into account the opinions of others.

Communicative competence is manifested in pupils' ability to listen to the interlocutor, to express the thoughts and to participate in dialogue and group work. Effective communication in primary school lays the foundations of social competence. This work correlates with studies by Italian scholars P. Zanchi & L. Zampini (2021), who revealed the particularities of developing pupils' skills of literary analysis of a text, which the authors regard as one of the key skills for the formation of the skills under study. The scholars analysed the oral narratives of primary school pupils using a narrative competence task, which made it possible to identify its gradual growth both at the

macrostructural and microstructural levels. In addition to the increase in chronological age, cognitive abilities (general non-verbal intelligence and sequential thinking) and linguistic skills (mean length of utterance and lexical diversity) played a significant role in explaining the variability of the macrostructure of the narrative of primary school pupils. Primary school pupils with higher cognitive and linguistic abilities produced more content-rich narrative stories, characterised by a greater amount of information, better structure and a wider use of mental vocabulary. In the context of out-of-school educational institutions in Ukraine, the particularities of developing primary school pupils' skills of communication while attending drama clubs and children's press centres were studied, during which pupils gained experience of public speaking. The indicators were pupils' use of different speech strategies, the ability to ask questions and to maintain a dialogue. In addition, this criterion envisaged checking the ability to work in a team, to share responsibilities and to achieve a common goal. The study by A. Han *et al*. (2021) confirmed that cooperative learning increases pupils' motivation and academic outcomes. The indicators were the pupils' willingness to help others, the ability to negotiate and to take responsibility.

Critical thinking in primary school pupils is manifested in the ability to analyse information, establish cause-and-effect relationships, ask questions, justify the position and distinguish facts from judgements when performing educational and practical tasks. In the course of the study, the formation of this skill in out-of-school educational institutions took place while solving problem tasks, participating in research projects and performing creative and experimental tasks. In particular, in science clubs and during environmental projects, primary education pupils learned to pose questions and test hypotheses. In out-of-school conditions, pupils had more freedom to experiment and therefore tried different approaches without fear of receiving a low mark. The indicators of formation were pupils' ability to explain the opinion, to propose arguments and to consider other opinions as an alternative. At a high level, pupils independently analyse situations and draw conclusions; at an average level, the pupils use the teacher's help; at a low level, the pupils only reproduce information.

The last criterion applied to the assessment of transversal skills of primary school pupils – application of knowledge in real-life situations – is an integral characteristic that determines the ability of primary school pupils to transfer school knowledge into everyday experience. One of the indicators of this criterion in the present study was the ability to cooperate effectively. In out-of-school institutions, pupils worked in groups on creative, scientific and sports tasks. This contributed to the development of such qualities of primary school pupils as mutual assistance, leadership, responsibility, and tolerance. Cooperation taught pupils to take into account the interests of others, to negotiate, to distribute roles and to achieve results together. A special role here was played by collective creative activities, which have now acquired new relevance in the light of the competence-based approach. In accordance with OECD (2021), cooperation is one of the key competences that is directly correlated with academic success and pupils' readiness for the future professional activity. Examples included keeping a "nature observation diary", solving everyday tasks (for example, calculating purchases in a shop) and participating in school fairs. The indicators of formation were the ability of primary school pupils to apply knowledge in new circumstances, to explain the practical significance of tasks and to propose the ways of solving problems.

Each pupil was assessed by primary school teachers according to the level of mastery of each criterion on four levels: high (10-11), sufficient (7-9), average (4-6) and low (1-3). In this way, data were obtained on the levels of mastery of the defined criteria of all pupils who took part in the pedagogical experiment. The results of the study of the levels of development of transversal skills of primary education pupils are presented in the histogram (Fig. 1).

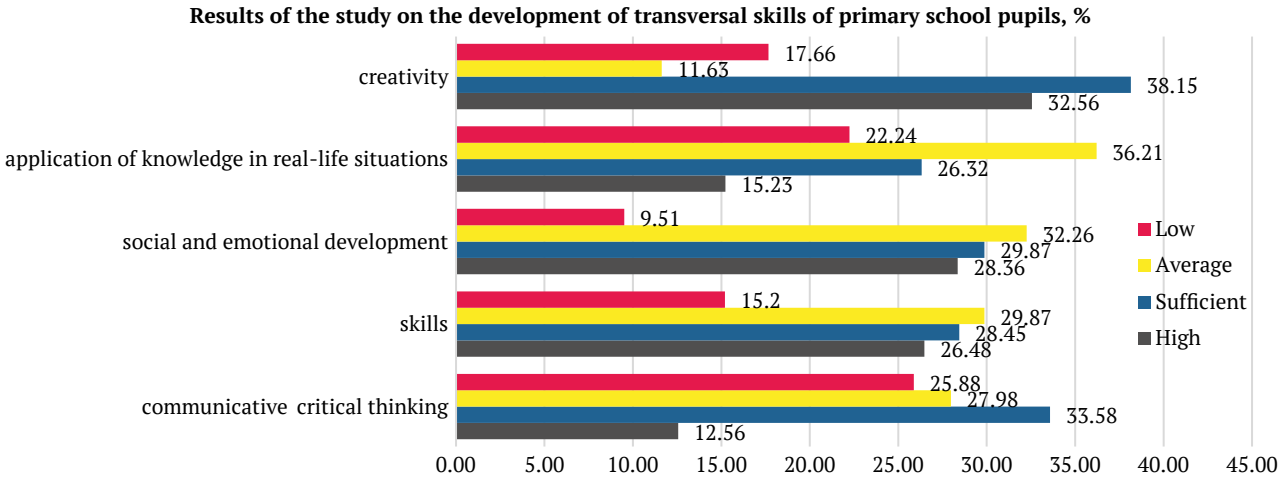

Figure 1. Results of the study of the levels of development of transversal skills of primary school pupils

Source: developed by the authors on the basis of the study

According to the results of the study, it can be noted that creativity is best developed in primary school pupils (32.56% of pupils possess this skill at a high level and 38.15% of respondents have a sufficient level of creativity), whereas the least developed is the ability to apply knowledge in real-life situations (the number of pupils who possess this skill at a high level is only 15.23%, while as many as 36.21% of respondents have a sufficient and 22.24% a low level). The levels of mastery of communication skills and social and emotional development in primary school pupils are approximately the same (a high level is characteristic of 26.48% and 28.36% of pupils respectively, and sufficient and average levels range from 28.36% to 32.26%). The results of the experiment prove that the critical thinking of primary education pupils is poorly developed, since only 12.56% of pupils possess a high level of critical thinking, and 25.88% of respondents have a low level of critical thinking. In this context, particular attention is required for pupils' ability to make well-founded decisions and to evaluate the consequences of the actions. W. Bruine de Bruin *et al*. (2020) proved that decision-making competence is not reduced solely to the level of intelligence but is formed as a complex of skills that includes critical analysis of information, risk assessment and the application of knowledge in real-life situations. This confirms the expediency of distinguishing the criterion "application of knowledge in real-life situations" as one of the key ones in the structure of transversal skills of primary school pupils.

These results emphasise the importance of developing not only basic skills but also the skills necessary for adaptation to the modern digital environment. Taking this into account, the study by G. Mustafa *et al*. (2025) pointed to the importance of early formation of digital literacy, which is important for preparing pupils for the conditions of digital transformation of education. The study identified factors that contributed to the effective implementation of the school digitalisation project: 1) provision of training for the development of the necessary skills, 2) a culture of support and exchange, 3) prior knowledge about tablets, 4) openness to learning, 5) perception of autonomy and competence to work in the new environment. The study was conducted taking into account change management and the satisfaction of psychological needs within the framework of the digital transformation of learning. However, in the study by M. Chicote-Beato *et al.* (2024), it was noted that measures to prevent cyberbullying are necessary from the first contact with technologies. In particular, emotional competence, self-regulation skills, school climate and online safety are factors that have a positive effect on preventing cyberbullying in primary school. Accordingly, in the present study, digital technologies were used, which made it possible to diversify teaching methods and to engage pupils in active cognitive activity. The use of digital tools was carried out in compliance with the rules of safe behaviour in the digital environment.

The use of online resources, virtual laboratories and interactive platforms expands opportunities for creativity and critical analysis of information. In the course of the study, primary school pupils, working with digital tools (for example, creating multimedia presentations), learned to search for and select information, to analyse its reliability and to use it in new conditions. This process contributes to the formation of the ability to learn throughout life and to the development of media literacy. The UNESCO (2017) study stresses that digital technologies must be integrated into all educational environments, including out-of-school institutions, for the development of key and transversal competences.

Transversal skills also include the formation of civic position, legal culture and responsible attitudes towards society (Sala *et al*., 2020). In out-of-school education, this aspect was implemented through participation in volunteering projects, environmental and educational activities and pupils' self-government. Primary school pupils who were involved in such practices began to realise the importance of personal contribution to the life of the community and responsibility for the actions; the pupils developed skills of critical assessment of social phenomena. The Concept of Civic Education in Ukraine and the Recommendations of the Council of Europe on Education for Democratic Citizenship and Human Rights define civic competence as one of the main transversal competences.

The study carried out shows that the formation of transversal skills requires interaction between schools and out-of-school educational institutions. Out-of-school educators supplement this process with professional support and specially organised forms of activity. Effective partnership is manifested in joint planning of the child's educational trajectories, in parents' support for the initiatives that the child implements in clubs, as well as in involving parents in the educational process as co-organisers of projects. Work on the formation of transversal skills proves that cooperation between school, family, and community significantly increases the effectiveness of forming pupils' key and transversal competences.

It is important to note that many scholars, including M. Alzahrani *et al.* (2019), O. Linnik *et al.* (2022) and K.L. Kaspar & S.L. Massey (2023), have proved that the formation of transversal skills is an important and valuable means of developing the personality of the primary school pupil. Therefore, the study demonstrated new findings regarding the formation of transversal skills of primary school pupils. The problem under study has become particularly important after the beginning of the coronavirus pandemic in 2019 and the full-scale invasion of Russia into the territory of Ukraine in 2022.

The works of M. Alzahrani *et al.* (2019) and K.L. Kaspar & S.L. Massey (2023) showed that one of the key transversal skills is the social and emotional development of primary education pupils, which, in turn, affects pupils' learning outcomes and the behaviour in society. The study conducted confirms these results and proves that this skill is important; however, in the conditions of distance learning it is quite difficult to develop it, especially in primary school

pupils, since the social and emotional development of primary school pupils presupposes communication with peers and the manifestation of empathy during communication. The obtained results are consistent with the conclusions of Ukrainian scholars O. Linnik *et al.* (2022), who studied 11 transversal skills of primary school pupils. At the same time, in the present study five main soft skills of primary school pupils were distinguished on the basis of expert evaluation by teachers, and the level of the formation was analysed. In addition, it is necessary to take into account the conditions of distance and blended learning in Ukraine, which do not always make it possible to assess the independence of pupils' thoughts and statements and the performance of all tasks. The subjective factor of the teachers who took part in the research process should also be considered.

CONCLUSIONS

The development of transversal skills in out-of-school education corresponds to international recommendations and national educational documents of Ukraine. The study conducted allows us to state that out-of-school educational institutions are a powerful environment for the formation of transversal skills in primary school pupils, since such institutions create conditions for the development of critical thinking, creativity, social and emotional intelligence, digital literacy, civic competence and the ability to cooperate. In the course of the study, on the basis of the scientific literature studied and by the method of expert evaluation, the following criteria of transversal skills of primary school pupils were defined: creativity, social and emotional development, communicative competence, critical thinking and application of knowledge in real-life situations. The obtained results show that creativity is best developed in primary school pupils, whereas critical thinking and the ability to apply knowledge in real-life situations are the least developed. The practical significance of the study lies in defining criteria for assessing transversal skills of primary school pupils, analysing the results of monitoring the formation using a comprehensive methodological approach that combined the analysis of scientific sources, empirical study of the formation of transversal skills of primary school pupils and expert evaluation by teachers, and envisaged the use of an interdisciplinary approach, the integration of innovative technologies and a focus on partnership with the family and the community, which makes it possible to create an individual educational trajectory for each pupil and to ensure the integrity of the educational process. The research materials can be used by teachers of out-of-school educational institutions and primary school teachers for the further development of transversal skills of primary school pupils in out-of-school educational institutions. Thus, it can be concluded that out-of-school educational institutions act as an important environment for the formation of transversal skills of primary school pupils, since such institutions ensure the development of critical thinking, communicativeness, digital literacy, creativity, the ability to cooperate, social and emotional intelligence and the ability to apply knowledge in real-life situations. In this way, out-of-school education becomes a powerful factor in educating a competent personality capable of learning throughout life and of taking an active part in the development of society. The prospects for further scientific research lie in developing means of fostering transversal skills of primary education pupils, which will be useful for primary school teachers and educators who work with primary school pupils in out-of-school educational institutions of Ukraine.

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Формування наскрізних умінь у молодших школярів в умовах позашкільних навчальних закладів

Анотація. Наскрізні уміння розглядаються як ключовий компонент розвитку молодого покоління, що підтверджується положеннями міжнародних документів та національних освітніх реформ України. Необхідність формування наскрізних умінь в українських школярів початкової школи набула особливої актуальності в контексті інтеграції України до європейського освітнього простору. Метою дослідження було визначення критеріїв оцінювання наскрізних умінь молодших школярів на прикладі Комунального закладу-центру позашкільної роботи Путивльської міської ради і Конотопського ліцею №7 імені Григорія Гуляницького Конотопської міської ради Сумської області та аналіз результатів моніторингу їх сформованості. У дослідженні було застосовано комплексний методологічний підхід, що поєднує аналіз наукових джерел, емпіричне вивчення сформованості наскрізних умінь у молодших школярів та експертне оцінювання рівня цих умінь у школярів педагогами. За результатами аналізу наукової літератури було уточнено сутність поняття «наскрізні вміння» у контексті розвитку ключових компетентностей учнів початкових класів, а також обґрунтовано значення позашкільної освіти для формування цих навичок і здатності молодших школярів застосовувати знання в практичних ситуаціях. На основі результатів методики експертного оцінювання, проведеного серед учителів та вихователів початкових класів, було визначено такі п'ять основних критеріїв оцінювання наскрізних умінь здобувачів початкової освіти: креативність, соціально-емоційний розвиток, комунікативна компетентність, критичне мислення та застосування знань у життєвих ситуаціях. Було представлено приклади педагогічних практик, які сприяють формуванню зазначених умінь, а також окреслено умови, за яких ці практики є найбільш ефективними для розвитку молодших школярів. Дослідження підкреслило значущість позашкільної освіти як простору для розвитку компетентної особистості молодшого школяра. Практична значущість дослідження полягає в можливості застосування результатів педагогами позашкільних навчальних закладів та вчителями початкових класів з метою подальшого розвитку наскрізних умінь молодших школярів в умовах позашкільних навчальних закладів

Ключові слова: креативність; критичне мислення; позашкільна освіта; соціально-емоційний розвиток; цифрова грамотність

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