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## Digital educational environment and the formation of motivation to learn a foreign language among young students

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**Abstract.** The relevance of the study is due to the growing role of the digital educational environment in the formation of motivation to study a foreign language among young students, for whom technological tools served as the main channel of educational interaction. The purpose of the study was to identify and model psychological and pedagogical conditions that ensure stable educational motivation of students aged 17-21 in a digital environment. The study applied a theoretical analysis of modern approaches to the study of motivation, systemic modelling of components of educational activity, structural and functional analysis of digital technologies. Based on the results obtained, a practical programme for the formation of motivation to study a foreign language in a digital environment was developed. The results of the study showed that students' motivation was determined by the interaction of three key components: awareness of the educational goal, emotional safety of the educational environment and sociocultural relevance of the educational material. The programme demonstrated an increase in students' cognitive activity, increased interest in completing educational tasks, improved attitude towards the use of digital tools, and increased readiness to apply knowledge in practical situations. Participants noted greater involvement in the educational process, a sense of support, and the ability to independently regulate the pace of learning, which contributed to the formation of intrinsic motivation. The practical value of the work lies in creating an integrated model of motivation for learning a foreign language in a digital environment and developing a programme that can be used in higher education institutions to improve the quality of foreign language teaching. The research materials can be used by teachers, methodologists, and developers of digital educational courses

**Keywords:** gamification; student learning activity; adaptive learning platforms; intrinsic motivation; psychological needs; educational technologies; multimedia learning tools

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### INTRODUCTION

In the modern educational space, the formation of motivation to learn a foreign language appears as a complex interdisciplinary problem, which is especially relevant in the context of the digitalisation of the educational process. The youth period (17-21 years), which falls on the period of obtaining higher education, is a sensitive period for the development of autonomy, professional identity and social integration. It is during this period that students' internal motivation is formed on the basis of cognitive maturity,

emotional self-regulation and social interaction. In modern conditions, students are often influenced by external digital stimuli, which can both activate interest in learning and reduce concentration and motivation due to information overload. At the same time, the integration of multimedia technologies – such as gamification, simulations, virtual reality and adaptive platforms – opens up new opportunities for personalising learning and supporting the motivational sphere of students.



In scientific discourse, motivation for learning is considered a key component of successful educational activity. Researcher J. Santrock (2020) showed that it is during adolescence that a cognitive breakthrough occurs, which allows students to comprehend goals, plan the educational trajectory, and critically evaluate the progress, emphasising the growth of reflexivity and the ability for metacognition as key factors in the formation of learning motivation. Researchers R. Ryan & E. Deci (2020) within the framework of the self-determination theory substantiated that motivation acts as a function of satisfying basic needs for autonomy, competence, and social interaction. Scientists developed a conceptual model that explained the mechanisms of the transition from extrinsic to intrinsic motivation through the process of internalising values and learning goals. Researcher F. Guay (2021) applied the self-determination theory to the educational context, showing that types of behavioural regulation, psychological needs, and autonomous-supportive behaviour of teachers directly influenced students' academic achievement.

Researchers Y. Wang *et al.* (2024) conducted a meta-analysis of the effectiveness of interventions based on self-determination theory and found that student- and teacher-centred approaches significantly improved intrinsic motivation and met students' basic psychological needs. Y. Wang (2024) found that interactive online learning environments can reduce anxiety, improve emotional well-being, and develop critical thinking skills in college students. Researchers J. Wong & B. Hughes (2023) concluded that the use of learning experience design principles in digital media could influence motivational characteristics that supported students' learning behaviour in undergraduate online courses.

Regarding the impact of gamification on motivation to learn a foreign language, researchers Z. Shen *et al.* (2024) found that gamification significantly and positively affected language learning achievement, with student motivation acting as a mediator in this relationship. Z. Luo (2023) conducted a systematic review of the effectiveness of gamified tools for foreign language learning and found mixed results and noted that most studies measured affective and behavioural engagement, while cognitive engagement remained understudied. S. Chan & N. Lo (2024) found that gamified educational frameworks clearly increased student engagement and motivation in the process of learning English, stimulated interest, and reduced anxiety. Researchers X. Wang *et al.* (2024) used structural equation modelling to find that the level of competence in the field of artificial intelligence and augmented and virtual reality technologies was a significant predictor of engagement and motivation.

In Ukrainian scientific works, L. Bondar & N. Lytvynchuk (2020) established the role of emotional and cognitive processes in the formation of the motivational sphere. R. Kyrychenko & A. Kolodiazna (2021) revealed the relationship between self-esteem, autonomy, and sustainability of motivation of future teachers. However, most existing studies focused either on general aspects of motivation or

on the influence of individual digital tools, without integrating cognitive, behavioural and humanistic approaches in relation to this age group. Also, insufficient attention was paid to the cultural and educational features of the Ukrainian context, which is critically important in the current conditions of reforming the higher education system. The aim of the study was to provide a theoretical justification for and methodological analysis of the factors of motivation formation for learning a foreign language in students aged 17-21 in a digital educational environment, taking into account the cognitive, emotional and sociocultural features of this age period.

## MATERIALS AND METHODS

The present study was theoretical and aimed at a comprehensive analysis of the factors that form motivation to learn a foreign language in students aged 17-21 in a digital educational environment. The methodological basis of the study was the integration of three key approaches to the analysis of motivation in education: cognitive, behavioural, and humanistic. Such integration allowed for a comprehensive interpretation of motivational processes in students: as a result of meaningful cognitive strategies and expectations (Vroom, 1964; Santrock, 2020), as a reaction to external stimuli and reinforcement (Skinner, 1953), as well as a manifestation of internal psychological needs. The combination of these approaches allowed for the creation of a multidimensional theoretical framework that can encompass various aspects of motivational processes in a digital educational environment. In this context, a special place was occupied by the self-determination theory (SDT) proposed by R. Ryan & E. Deci (2020), which considered motivation as a function of satisfying basic needs for autonomy, competence, and social interaction. This theory was chosen as the central methodological basis of the study, since it most fully reflected the specifics of youth period, when the need for autonomy and self-determination is particularly acute. SDT allowed explaining the mechanisms of the transition from extrinsic to intrinsic motivation, which was critically important for the formation of a sustainable interest in learning a foreign language.

As part of the study, a conceptual analysis of five interconnected theoretical models was carried out, which together formed the methodological basis for studying the impact of digital educational technologies on motivation to learn a foreign language. The Attention, Relevance, Confidence, Satisfaction (ARCS) model, developed by J. Keller (2010), was chosen to analyse the motivational design of the digital learning environment. This model allowed structuring four key components of motivation: attracting students' attention, ensuring the relevance of educational material to the life goals, building confidence in the students' abilities and creating a sense of satisfaction from achievements. The Substitution, Augmentation, Modification, Redefinition (SAMR) model, analysed by M. Kharbach (2025), was used to classify the levels of integration of digital technologies into the educational process – from a simple replacement

of traditional tools to a complete rethinking of educational activities. This model made it possible to assess how deeply digital technologies transformed students' motivational processes. The Technological Pedagogical Content Knowledge (TPACK) model, proposed by P. Mishra & M. Koehler (2006), was used to analyse the integration of technological, pedagogical and subject knowledge of teachers. This model served as an architectural framework that ensured pedagogically sound design of the educational process and was most closely associated with the cognitive component of motivation through the structure of educational content and the effective selection of digital tools. The Computer-Assisted Language Learning (CALL) approach, first described by J. Higgins (1983) and updated by H. Reinders & S. Chong (2023), was used to analyse the specifics of the use of computer technologies in foreign language learning, which ensured the practical implementation of language experience in a digital environment. SDT served as a unifying framework for interpreting the results of the analysis of all previous models through the prism of satisfying the basic psychological needs of students. The choice of these five models was justified by the complementarity: ARCS modelled motivational dynamics, SAMR determined the degree of digital transformation, TPACK provided a pedagogical basis, CALL focused on the specifics of language learning, and SDT provided a psychological justification for all processes. Together, these models made it possible to explain how the digital environment activated motivational mechanisms through relevance, involvement, gamification, adaptation of educational content, and support for students' psychological comfort.

The main research method was a systematic analysis of scientific literature, which included the search, selection and critical analysis of modern works on pedagogical and age psychology, educational theory and empirical studies of the impact of digital technologies on the educational activity of young people. The source base comprised publications from international scientometric databases (Scopus, Web of Science, PubMed) for the period 2020-2025, which ensured the relevance and significance of the analysed material. The criteria for selecting sources were: the presence of empirical data on the impact of digital technologies on student motivation, focus on the age group of 17-21 years or students of higher education institutions, application of the theory of self-determination or other relevant motivational theories and publication in peer-reviewed scientific publications. To illustrate theoretical provisions and visualise the relationships between the components of motivation, digital educational platforms Quizlet, Duolingo, and Kahoot! were used, which were selected as representative examples of the practical implementation of the models under study. The analysis of the functionality of these platforms was carried out through the prism of the ARCS, SAMR and CALL models to determine the mechanisms of influence on various components of motivation. Structural-functional analysis was used to systematise the components of motivation (cognitive, emotional and sociocultural) and determine the

functions of each component in the formation of sustainable learning motivation.

Comparative analysis was used to compare the effectiveness of different methodological approaches (cognitive, behavioural and humanistic) in the formation of motivation of young students. The theoretical modelling method allowed creating an integrated model of the formation of motivation for learning a foreign language in a digital environment, which combined all five theoretical approaches studied. The modelling procedure involved the sequential derivation of the structural components of the model from the provisions of each theory: three basic psychological needs (autonomy, competence, social interaction) were taken from SDT, which determined the target orientations of the entire model; four motivational components (attention, relevance, confidence, satisfaction) were derived from the ARCS model, which formed the structure of each training module; the SAMR model identified the levels of digital transformation of training tasks – from replacing traditional exercises to rethinking language practice through immersive technologies; TPACK provided the pedagogical basis for the integration of technological, methodological and linguistic content, defining the principles of selecting digital tools; CALL specified the specifics of computer-mediated language learning through interactive exercises, automated feedback and adaptive algorithms. Based on this synthesis, the Language XP programme modules were formed: an autonomous learning module (realisation of the need for autonomy through SDT + personalisation according to ARCS), a competency development module (gradual complication of tasks according to SAMR + confidence formation according to ARCS), a social interaction module (collaborative tasks based on CALL + satisfaction according to ARCS) and a gamified practice module (transformational level of SAMR + relevance according to ARCS), all modules were designed taking into account the principles of TPACK to ensure the pedagogical feasibility of technological solutions. Tables and figures were used to visualise the results of the theoretical analysis. The result of the development was a methodological justification for the procedure for assessing the effectiveness of the model. It involves the implementation of the Language XP programme in the educational process, with subsequent diagnostics using validated tools. The proposed structure allows for comprehensive monitoring of the dynamics of internal motivation, the level of psychological comfort and the quality of students' academic results in a digital environment.

## RESULTS AND DISCUSSION

Analysing the theoretical basis of the motivational sphere in students aged 17-21, it is worth focusing on the basic definitions, cognitive characteristics and social changes that affect the educational activity. The formation of motivation to learn a foreign language in students aged 17-21 is based on a combination of psychological, age and sociocultural factors. According to the scientific literature, motivation is considered as a central regulator of

behaviour that determines the direction, intensity, and duration of educational activity (Ryan & Deci, 2020; Kyrchenko & Kolodiazna, 2021). In this context, it is relevant to clarify key concepts: motivation is an internal or external stimulus that activates and organises the behaviour of an individual to achieve certain goals. It acts as an integrator of needs, interests, and values; motivation for learning – a type of learning activity, driven by interest in the subject, the significance of knowledge, or social expectations (Bondar & Lytvynchuk 2020); motivational sphere of personality – a system of stable motives that determine educational behaviour and the ability to overcome difficulties on the

way to achieving goals (Mata & Hertwig, 2011; Symonds *et al.*, 2019). As already noted, adolescence (17-21 years) is a critical stage of psychological development, when the ability to be independent, professional self-determination, and conscious learning is formed. During this period, cognitive processes intensify, reflexivity increases, and social identity is strengthened, which directly affects the structure and dynamics of motivation for educational activity. Taking into account these changes, it is possible to distinguish three main domains of age development that have the greatest impact on motivation for learning a foreign language, which is reflected in Table 1.

**Table 1.** Three key domains of age development that influence motivation

No.	Development domains	Characteristics of the age group 17-21 years	Impact on motivation to learn a foreign language
1	Cognitive	The ability to plan, metacognition, and abstraction increases	Strengthens self-regulation and strategic thinking in learning
2	Emotional	Emotional stability is formed, anxiety is reduced	Provides endurance in learning, reduces fear of mistakes
3	Social / sociocultural	Professional identity and group interaction are developing	Stimulates extrinsic motivation through feedback and recognition

**Source:** compiled by the author based on E.H. Erikson (1968), J.J. Arnett (2000), R. Mata & R. Hertwig (2011), J.W. Santrock (2020), R. Ryan & E. Deci (2020)

The age interval 17-21 years, according to the concept of “emerging adulthood” by J.J. Arnett (2000), is a period of active self-determination, when a young person seeks a balance between individual autonomy and social belonging. The theory of psychosocial stages of development by E.H. Erikson (1968) defines this period as a transition from identity to closeness, where motivation to learn is associated with an understanding of one’s place in society. According to J.W. Santrock (2020), during this period a cognitive breakthrough occurs, which allows one to comprehend goals, plan an educational trajectory and critically evaluate one’s own progress. These factors form a favourable soil for the development of intrinsic motivation, especially in a digital environment that meets individual needs and learning styles. Given the specifics of students’ cognitive, emotional, and social development in adolescence, it is appropriate to consider how these aspects are manifested in the structure of the motivation to learn a foreign language. Motivation at this stage of life is formed as a multidimensional system, based on the interaction of three key components – cognitive, emotional, and sociocultural. Each of these components plays a unique role in supporting or inhibiting learning activity, especially in the digital educational environment.

The cognitive aspect of motivation is associated with the student’s mental activity: setting goals, planning learning activities, reflecting on results, and the ability for metacognition – conscious control over one’s own thinking (Santrock, 2020). Students who have well-developed

cognitive strategies plan learning tasks more effectively, independently organise the time, and demonstrate greater resilience to difficulties. In the context of digital learning, this is manifested in the use of adaptive platforms, time management in online courses, and the formation of individual educational trajectories. For example, interactive programmes such as Quizlet or Duolingo, which require regular planning and monitoring of progress, activate the cognitive sphere of motivation. It is associated with the student’s ability to predict the outcome, independently adjust learning behaviour, and achieve autonomy in language acquisition (Ryan & Deci, 2020). The emotional sphere determines how the student experiences the learning process, what emotions are associated with learning, and how these emotions affect the sustainability of motivation. The period from 17 to 21 years of age is characterised by increased sensitivity to evaluation, the need for self-affirmation, and the importance of support from the environment (Erikson, 1968; Arnett, 2000). High self-esteem and a sense of success increase intrinsic motivation, while anxiety, fear of making mistakes, or comparing oneself to others can block it. The emotional component is especially activated in digital learning environments, when students work independently.

Platforms such as Kahoot! or Edmodo, which provide positive emotional feedback, increase motivation through the achievement effect. Support from the teacher and the group is also a key factor in creating a safe emotional environment where motivation is not suppressed by feelings of

insecurity (Ryan & Deci, 2020). The sociocultural component of motivation is formed on the basis of identity, cultural belonging, and social expectations. At the age of 17-21, students are actively searching for the place in society, and learning a foreign language is perceived as a tool for social advancement, integration, and mobility (Arnett, 2000). The formation of a positive perception of one's own education and competence in intercultural communication stimulates internal and external motivation. The digital environment opens up wide opportunities for cultural interaction: participation in international projects, online communities, and exchange of experience with native speakers. For

example, platforms such as iTalki or Tandem, create conditions for intercultural dialogue, which enhances sociocultural motivation through the experience of authentic communication and inclusion in the global language environment. Given the complex nature of motivation for learning in young students and its multi-component structure, special attention is paid to the choice of adequate methodological approaches to its formation in the digital educational environment. Each of the approaches – cognitive, behavioural, and humanistic – offers its own understanding of the mechanisms of motivation, focusing on its various determinants (Table 2).

**Table 2.** Comparative table of methodological approaches to the formation of motivation

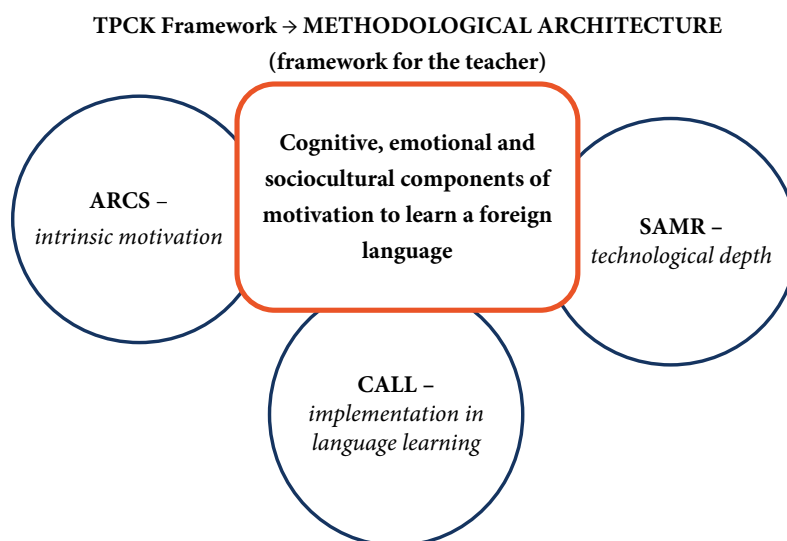
Approach	Key ideas	Strengths	Limitation	Elements for integration
Cognitive	Motivation as a result of expectations, goals, metacognition	Supports autonomy, develops thinking, self-regulation	May decrease in the face of failure or low self-esteem	Planning, reflection, strategic learning
Behavioural	Motivation is formed through reinforcement	Fast activation, efficiency at the initial stage	Does not form a sustainable interest, depends on external stimuli	Gamification, rewards, feedback
Humanistic	Motivation as a desire for self-realisation	Promotes internal motivation, autonomy, and psychological comfort	Requires an individual approach, difficult to implement in mass education	Autonomy support, meaning, personal significance

**Source:** compiled by the author based on B. F. Skinner (1953), V. Vroom (1964), R. Ryan & E. Deci (2020), J.W. Santrock (2020), J.J. Arnett (2000)

The analysis of the characteristics presented in Table 2 demonstrates that each of the three approaches – cognitive, behavioural and humanistic – highlights only certain aspects of motivational processes in the digital educational environment, which justifies the use of an integrative methodology in this study. This is especially true for young students, who are characterised by the need for structure, emotional support and autonomy at the same time. In this regard, an integrative approach that combines strategic thinking, external stimulation and the development of intrinsic motivation seems appropriate. Such an approach creates conditions for the formation of a flexible motivational system that is able to adapt to the dynamics of the educational process and the individual needs of students.

After analysing the components of motivation, it becomes appropriate to consider how modern educational technologies can serve as catalysts for motivational processes in students aged 17-21. In this context, attention is focused on three key areas: multimedia technologies, theoretical models of digital media integration in learning, and applied solutions in the field of foreign language learning. The analysis of theoretical models and digital solutions in the field of foreign language learning allows asserting that educational technologies are not only a tool for knowledge transfer, but also a powerful stimulator of cognitive, emotional, and social motivation of young students. Due to the combination of interactivity, personalisation, and

gamification, multimedia solutions are a powerful factor in forming and maintaining motivation for learning. One of the key mechanisms is gamification – the inclusion of game elements, such as points, badges, and ratings, which stimulate motivation through the mechanism of competition and expectation of rewards. This is especially effective for young students who are inclined to seek achievements and social recognition. Another example is virtual reality environments that provide the effect of immersion in a language context. Such environments increase emotional engagement, create a sense of presence in real communicative situations, and help reduce the fear of making mistakes – a factor that significantly affects students with high levels of anxiety or low self-esteem. Another tool is adaptive learning platforms that can adapt to the individual pace of the student, analyse typical errors and take into account the student's interests. This stimulates cognitive activity, enhances self-reflection and promotes the development of metacognitive strategies. Therefore, the use of multimedia technologies allows simultaneously activating the cognitive, emotional and sociocultural components of motivation, creating a more holistic and effective educational environment. The integration of the ARCS, SAMR, CALL and TPCK models into the educational process allows creating a complex motivational system, where each model performs a unique function within the cognitive, emotional and sociocultural components (Fig. 1).



**Figure 1.** An integration model for the application of ARCS, SAMR, CALL, and TPCK models in the formation of motivation for learning a foreign language in a digital educational environment

**Source:** developed by the author based on B.F. Skinner (1953), V. Vroom (1964), E.R. Ryan & E. Deci (2020), J.W. Santrock (2020), J.J. Arnett (2000)

As can be seen in Figure 1, the TPCK (Technological-Pedagogical-Content Knowledge) model serves as an architectural framework that ensures the consistent application of other models – ARCS, SAMR, and CALL – in the motivational environment of digital learning. The results of the study showed that although TPCK does not directly affect motivation, it creates the conditions for its implementation through pedagogically sound design of the educational process. This model is most closely related to the cognitive component of motivation: it contributes to the structuring of educational content, the effective selection of digital tools and the activation of students' metacognitive strategies. In this context, the ARCS model structures motivational dynamics through a focus on attention, significance, confidence and satisfaction, SAMR determines

the degree of digital transformation of learning, and CALL provides practical implementation of language experience in a digital environment. Thus, the integration of these approaches allows influencing all three key components of motivation – cognitive, emotional and sociocultural – and forms a holistic psychological and pedagogical strategy adapted to the characteristics of young students. In order to systematise the impact of the developed programme on the key components of motivation of students aged 17-21, a summary table of the modules of the developed Language XP programme is presented below. Each module combines specific tools and methods aimed at activating the cognitive, emotional, and sociocultural potential of the student, which allows for the holistic implementation of an integrated model of motivational support (Table 3).

**Table 3.** Language XP programme modules and the impact of these modules on students' motivational components

Language XP module	Basic tools	Motivation component	Theoretical models
Activation module	Motivational interview, video introduction, setting individual goals	Cognitive, emotional	ARCS, TPCK
Gamified workshop	Gamified exercises, points, badges, and ratings system	Emotional, cognitive	ARCS, SAMR
VR communication module	VR scenarios, interactive role-playing communication	Sociocultural, emotional	SAMR, CALL
Reflective module	Digital diary, self-assessment, coaching	Cognitive	ARCS, TPCK
Language hub / CALL module	Authentic materials, immersive tests, audio, and video chats	Sociocultural, cognitive	CALL, TPCK

**Source:** developed by the author

As can be seen from Table 3, each programme module performs a target function within one or several motivational vectors. The gamified workshop supports the emotional component through a system of points, skill levels (from “Novice” to “Expert”), virtual badges and weekly

competitions. This system activates the dopaminergic mechanisms of the brain and satisfies the need for competence, demonstrating to students the progress. The reflective module promotes cognitive self-regulation through digital learning diaries with metacognitive questions about

the effectiveness of strategies and areas for improvement. Automatic visualisation of progress through graphs enhances the sense of autonomy and control over learning. The virtual reality module simultaneously activates all three components: cognitively creates an authentic context for language practice, emotionally reduces the fear of error through interaction with virtual characters, socioculturally models real communicative situations in a cultural context. Adaptive trajectories analyse patterns of learning behaviour (speed of execution, types of errors, preferences for formats, productive time of day) and automatically adjust the complexity and format of tasks. Such personalisation supports a sense of competence, ensuring work in the zone of optimal development. The social interaction module creates virtual language communities based on interests, organises online meetings with native speakers, and selects language partners, satisfying the need for social connectedness. The integration of the ARCS, SAMR, TPCK, and CALL models in each module provides a balanced impact: ARCS supports attention, relevance, confidence, and satisfaction; SAMR determines the level of technological transformation; TPCK guarantees pedagogical validity; CALL provides the principles of communicative competence and authenticity. The Language XP programme represents a comprehensive motivational system with a synergistic effect of supporting all components of student motivation. The results of the theoretical study are consistent with modern empirical data on the key role of the digital educational environment in shaping students' motivation to learn a foreign language. The proposed integrated model was confirmed in studies of the period 2020-2025.

In particular, the results obtained in the study are consistent with the scientific findings of Q. Zheng *et al.* (2025), who proved that digital literacy of EFL students is a significant predictor of the effectiveness in online learning. At the same time, the authors emphasised the mediating role of perceived teacher support, which indicates the decisive importance of pedagogical support even in a technologically saturated environment. This position correlates with current findings on the need to combine digital tools with the facilitatory role of the teacher within the TPCK model. Similarly, the results of M. Vansteenkiste *et al.* (2018) and A. Rezai *et al.* (2025) confirm the importance of informal digital learning of English (IDLE) as a factor in shaping students' motivational sphere. The authors found significant relationships between IDLE, online motivation, learning satisfaction, and telecollaborative anxiety levels, demonstrating that extracurricular digital activity can not only enhance positive emotional experiences but also reduce barriers to cross-cultural communication. This expands the understanding of the sociocultural component of motivation embedded in the current integrated model.

Regarding the central role of self-determination theory in the proposed model, a meta-analysis by Y. Wang *et al.* (2024), which analysed 344 samples (223,209 participants), found that satisfaction of basic psychological needs is a key predictor of academic motivation. These results

justify the feasibility of building the Language XP model around the three basic needs of SDT and support the expansion of the theoretical propositions by demonstrating the possibilities of structuring digital technologies according to the ARCS, SAMR, TPCK, and CALL models. Researchers J. Howard *et al.* (2024) conducted a meta-analysis of 637 samples (N = 388,912) and found that autonomy support had the largest effect among the three basic needs. These data reinforce the Language XP model's emphasis on autonomy as a key need for adolescent students, and justify the priority of the autonomous learning module in the programme structure.

Regarding the role of gamification, a study by Z. Shen *et al.* (2024) found a significant positive effect of gamification on language learning achievement, with motivation as a mediator, confirming the feasibility of including a gamified module in Language XP. Importantly, the authors found a moderating role of digital literacy – gamified approaches were more effective for students with higher technological competence. These results indicate the need to diagnose the level of digital literacy of students before implementing the programme and possibly adapt the complexity of gamified elements. Researcher Z. Luo (2023) found mixed results regarding gamification and insufficient study of cognitive engagement in existing tools. The identified gaps justify the structured approach of the Language XP model, where gamification elements are clearly linked to motivational components (attention, relevance, confidence, enjoyment according to ARCS) and psychological needs (autonomy, competence, social interaction according to SDT), which can provide simultaneous support for cognitive, affective and behavioural engagement. Researcher R. Rajapakse (2024) found that excessive information load in the digital environment could reduce students' concentration and motivation due to cognitive overload. Researcher M. Chen (2024) demonstrated that emotional intelligence had a significant impact on the academic achievement of college students, which highlighted the importance of the emotional component in digital learning.

Regarding technological literacy, X. Wang *et al.* (2024) found that AI and AR/VR literacy significantly predicted EFL student engagement and motivation. These results complement the Language XP model by supporting the rationale for introducing technologies at varying levels of difficulty, from basic interactive exercises to immersive VR simulations, according to SAMR levels. Q. Zheng *et al.* (2025) found that perceived teacher support mediated the relationship between digital literacy and the power of online learning, highlighting the importance of the human factor. These findings reinforce the model's premise of the teacher as a facilitator (as per TPCK) and suggest the need for specific teacher training for effective implementation of Language XP. The findings of D. Pérez-Jorge *et al.* (2025) demonstrate the positive impact of VR and AR on motivation, especially for students with language anxiety, which justifies the inclusion of immersive technologies in the gamified practice module and expands the

understanding of the therapeutic potential. Researchers A. Rezai *et al.* (2025) found that informal digital English learning was positively correlated with online motivation in a sample of 532 students. These results complement the Language XP model by substantiating the importance of the sociocultural component and the possibility of integrating students' informal digital practices (social networks, video content, games) into a structured curriculum. Q. Huang (2025) found that technologies significantly reduced language anxiety through the creation of supportive environments, which strengthens the proposition about the emotional component of motivation and justifies the design of a safe digital space in Language XP.

At the same time, some results from other studies indicate potential limitations and areas for improvement of the model. G. Liu *et al.* (2024) found that extrinsic motivation did not predict student satisfaction, highlighting the criticality of intrinsic motivation. These data indicate the need for special attention to the balance of intrinsic and extrinsic motivators when implementing the Language XP programme, and the possible strengthening of elements that support the internalisation of learning goals. K. Dai & Y. Wang (2024) found a complex interaction between satisfaction, anxiety, and boredom in a technological environment. These results complement the Language XP model with an understanding of the need for flexible adaptation to individual differences in students and the possible implementation of emotional state monitoring mechanisms for timely correction of the learning process.

Summarising the results of the comparative analysis, it can be stated that the proposed Language XP model is consistent with the main trends of modern research published between 2020 and 2025. In particular, the central role of basic psychological needs according to the theory of self-determination, the positive impact of gamification on academic achievement and motivation, the critical importance of students' technological literacy for the effective use of digital tools, the potential of virtual and augmented reality technologies in reducing language anxiety, as well as the need for pedagogical support for teachers in the digital environment are confirmed. At the same time, the Language XP model differs from existing research in its specific focus on the age group of 17-21 years, which allows taking into account the peculiarities of the youth period, in particular the increased need for autonomy and professional self-determination. A key feature of the model is the systematic integration of cognitive, emotional and sociocultural components of motivation through five complementary theoretical models – ARCS for motivational design, SAMR for levels of digital transformation, TPCK for pedagogical framework, CALL for the specifics of language learning and SDT for the psychological justification of all processes.

## CONCLUSIONS

The results of the theoretical analysis confirmed that the motivation to learn a foreign language in young students

was formed as a multicomponent phenomenon, based on the interaction of cognitive, emotional and sociocultural factors. The greatest influence on the sustainability of motivation was the possibility of conscious planning of learning and self-regulation, positive emotional experiences associated with success and support, as well as intercultural interaction that activated the linguistic identity of students. The proposed integrated model of the digital educational environment, which combined the principles of SDT with the ARCS, SAMR, TPCK and CALL models, provided a theoretical basis for the systematic support of motivation through targeted influence on its key components. The cognitive component was supported through metacognitive strategies and reflective practices, the emotional component through gamification and the creation of a psychologically safe environment, and the sociocultural component through authentic intercultural interaction and immersion in the linguistic environment. Theoretical modelling showed that digital technologies (adaptive platforms, VR simulations, social networks) could be structured in accordance with the basic psychological needs of students (autonomy, competence, social connectedness), creating conditions for the formation of intrinsic motivation.

The complementarity of the selected theoretical models allowed taking into account the specifics of adolescence: the need for autonomy while maintaining structured support, the importance of social recognition, and the connection of learning with professional self-determination. The systematisation of motivational components and the development of corresponding modules of the digital environment demonstrated the possibility of creating a balanced system of motivational support, where each element performed a specific function, and the combination created a synergistic effect. An integrated approach to the motivational design of the digital learning environment potentially allowed increasing the level of student engagement, making learning more personalised, emotionally meaningful, and culturally relevant. Prospects for further research include empirical testing of the proposed theoretical model, quantitative measurement of the effectiveness of individual components in different academic environments, studying the influence of motivational factors on long-term retention of interest in language learning, and expanding the model for students with different learning styles and levels of language training.

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## Цифрове освітнє середовище та формування мотивації до вивчення іноземної мови в студентів юнацького віку

**Анотація.** Актуальність дослідження зумовлена зростанням ролі цифрового освітнього середовища у формуванні мотивації до вивчення іноземної мови серед студентів юнацького віку, для яких технологічні інструменти виступали провідним каналом навчальної взаємодії. Метою дослідження було визначення та моделювання психолого-педагогічних умов, що забезпечують стійку навчальну мотивацію студентів 17-21 років у цифровому середовищі. У роботі було застосовано теоретичний аналіз сучасних підходів до вивчення мотивації, системне моделювання компонентів навчальної діяльності, структурно-функціональний аналіз цифрових технологій. На основі отриманих результатів було розроблено практичну програму формування мотивації до вивчення іноземної мови в цифровому середовищі. Результати дослідження показали, що мотивація студентів визначалася взаємодією трьох ключових компонентів: усвідомленням навчальної мети, емоційною безпекою освітнього середовища та соціокультурною релевантністю навчального матеріалу. Програма засвідчила зростання пізнавальної активності студентів, підвищення інтересу до виконання навчальних завдань, покращення ставлення до використання цифрових інструментів і зростання готовності застосовувати знання у практичних ситуаціях. Учасники відзначили більшу залученість у навчальний процес, відчуття підтримки та можливість самостійно регулювати темп навчання, що сприяло формуванню внутрішньої мотивації. Практична цінність роботи полягає у створенні інтегрованої моделі мотивації до вивчення іноземної мови в цифровому середовищі та розробленні програми, яку можна використовувати у закладах вищої освіти для підвищення якості навчання іноземної мови. Матеріали дослідження можуть бути застосовані викладачами, методистами та розробниками цифрових освітніх курсів

**Ключові слова:** гейміфікація; навчальна активність студентів; адаптивні навчальні платформи; внутрішня мотивація; психологічні потреби; освітні технології; мультимедійні інструменти навчання

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## Learning technologies and professional competence development for future IT specialists in the context of sustainable development

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**Abstract.** The aim of the study was to examine the tools and technologies used in the educational programmes of leading technical universities in Ukraine to train future IT specialists. The research methodology included a survey of 312 students and 28 lecturers, an analysis of digital platforms and technologies, as well as a comparative analysis of the effectiveness of the tools used to develop the professional competence of future IT specialists in the context of sustainable development. The study examined the impact of modern digital technologies on the development of professional competence of future IT specialists. The active use of platforms such as GitHub, Moodle, Cisco Networking Academy, and cloud tools confirmed a positive impact on the development of practical skills and critical thinking. The study found that 89 students recognised these technologies as effective for professional growth. More than 176 respondents participated in projects that incorporate the principles of sustainable development, indicating the integration of environmental and ethical aspects into the learning process. In addition, 167 students noted the effectiveness of online courses on the Coursera and edX platforms for in-depth study of the material, which increases their competitiveness. Analysis of the results showed that services such as GitHub, Docker, AWS Educate, and Cisco Networking Academy play a key role in shaping practical, project-oriented skills. On the other hand, learning management tools such as Moodle and Microsoft Teams have a different functional purpose and are used primarily for communication, learning material management, and educational environment support, rather than for developing applied technical competencies. The practical significance of this work is that it can be used by lecturers, educational institutions, and curriculum developers to improve the training of IT specialists by integrating modern digital tools and technologies into the learning process, taking into account the principles of sustainable development

**Keywords:** educational process; training of specialists; innovative technologies; programming process; practical skills

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### INTRODUCTION

The relevance of the research topic was determined by transformational processes in education and the growing requirements for the content and forms of organisation of professional training. Contemporary changes in the higher education system include the integration of new digital technologies, the modernisation of teaching methods, and the renewal of approaches to training specialists in Field F "Information Technologies" (in particular areas F1-F7,

among which F1/121 "Software Engineering" is of particular importance). This creates the need to develop future IT specialists' ability to work with modern information systems, apply data analytics, and design and implement innovative technological solutions that meet the current needs of the IT sector. However, at the present stage of educational science development, there is still a lack of systematic research into how innovative educational technologies can



be integrated into the training of IT specialists specifically with regard to the principles of sustainable development. The absence of clearly defined methodological approaches to combining professional training with the ideas of sustainability hinders the holistic development of such qualities among students as environmental awareness, social responsibility, critical thinking, and the ability for interdisciplinary interaction. In addition, there was a shortage of empirical studies that would make it possible to substantiate the effectiveness of particular didactic models, digital platforms, or project-based learning methods in the development of sustainable professional competencies.

A number of researchers have examined various aspects of training future IT specialists. In particular, Y. Tryus & I. Herasymenko (2021) analysed approaches, models, methods and tools for training future IT specialists using elements of dual education. They demonstrated the effectiveness of combining academic learning with practical experience, which contributes to better adaptation of students to the needs of the IT market. M. Váraljai *et al.* (2024) explored the possibilities of shaping students' thinking through the implementation of innovative IT tools and project management technologies in higher education. The authors substantiated the need for flexible digital solutions that ensure the adaptability of the learning process to contemporary requirements. V. Yunchyk *et al.* (2021) proposed a cognitive model of the IT specialist training process that takes into account the specific features of students' perception and information processing. The model made it possible to formalise educational activities and adapt curricula to the cognitive characteristics of learners. L. Pavlenko & M. Pavlenko (2024) examined augmented reality tools as a component of a modern educational environment for IT specialists. The researchers demonstrated that AR technologies significantly enhance the visualisation of abstract concepts and contribute to deeper learning. A practice-oriented approach to training IT students through the use of virtual reality in the field of programmable logic controllers was proposed by K. Kubola *et al.* (2022). They showed that VR tools make it possible to create a safe, cost-effective and realistic environment for practising technical skills. O. Markova & M. Marienko (2021) investigated the use of cloud-based workshops in the training of future IT specialists, confirming that such workshops enhance flexibility, accessibility and students' technological literacy. O. Karupu *et al.* (2021) proposed a model for developing the professional skills of future aviation and IT specialists based on practical mathematical training with the use of information technologies. Their research confirmed a close link between a strong technical foundation and the IT competence of students. In addition, T. Kovaliuk *et al.* (2020) applied an ontological approach to the development and accreditation of educational programmes for training IT specialists in Ukraine, substantiating the advantages of structured knowledge representation for improving the quality of education.

O. Kopishynska *et al.* (2020) substantiated professionally oriented training of specialists through the

implementation of cloud information systems, emphasising the need for close cooperation between higher education institutions and IT companies. The authors demonstrated that this format of education makes it possible to align the content of academic training with current labour market requirements, while simultaneously developing students' practical skills that enhance their competitiveness. Particular attention was paid to the introduction of modern cloud technologies into the educational process as a means of developing digital competencies. F. Fraile *et al.* (2023) developed a comprehensive methodological framework for creating personalised learning programmes aimed at upskilling the workforce within the context of the Industry 5.0 concept. In particular, Industry 5.0 focuses on integrating humans into processes of automation and robotisation, with an emphasis on collaboration between people and technologies in order to achieve sustainable development and the personalisation of production processes. In their study, the authors highlighted the importance of taking into account individual needs and levels of prior training, which makes it possible to achieve greater effectiveness in learning and in the development of relevant IT competencies. The proposed model considers adaptability, flexibility and digital transformation as key factors of contemporary education for specialists working in a dynamic, technology-oriented environment.

Despite these significant findings, existing research does not sufficiently address the integration of emotional intelligence, social interaction and interdisciplinarity in the training of IT specialists. In addition, the long-term impact of the proposed models on graduates' adaptation to dynamic changes in the digital labour market has been analysed only to a limited extent. Moreover, despite the aforementioned studies, there remains insufficient investigation into how the integration of sustainable development principles influences the content and structure of educational programmes for IT specialities. Furthermore, the pedagogical conditions under which digital learning technologies effectively contribute to the development of professional competence with due regard to environmental and social responsibility remain underexplored. The aim of the study was to identify contemporary educational technologies that contribute to the development of the professional competence of future IT specialists in the context of sustainable development. The objectives of the study were to analyse digital platforms and tools used in the training of future IT specialists; to determine the impact of educational technologies on the development of professional competence in the context of sustainable development among future IT specialists; and to formulate recommendations for the development of professional competence of future IT specialists in the context of sustainable development.

## MATERIALS AND METHODS

The study involved 312 students and 28 lecturers from five higher education institutions that offered training for specialists in the Bachelor's Programme in Computer

Science (n.d.) and the Bachelor's Programme in Software Engineering (2020). The inclusion criteria for students were: studying in the 3<sup>rd</sup> or 4<sup>th</sup> year of a bachelor's degree or in a master's degree programme, active participation in educational projects, and use of modern IT platforms in learning. The inclusion criteria for lecturers were teaching core IT-related disciplines, experience in implementing digital educational technologies, and participation in the implementation of sustainable development programmes. First-year students, as well as those who had no experience with project-based learning or did not use the specified digital tools in the educational process, were excluded from the sample. Lecturers whose activities were limited exclusively to theoretical courses without the application of innovative technologies were also excluded. The study was empirical in nature with elements of applied analysis and was conducted between 2021 and 2024. The main objective was to examine the effectiveness of modern educational technologies in developing the professional competence of future IT specialists in the context of sustainable development.

Data were collected using the Google Forms (2024) in an online format through a questionnaire administered to students of the "Computer Science" and "Software Engineering" specialities at five leading technical universities:

the National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute", Kharkiv National University of Radio Electronics, Lviv Polytechnic National University, Oles Honchar Dnipro National University, and Odesa Polytechnic National University. These higher education institutions were selected due to their high level of academic training in the field of information technology, the availability of modern digital infrastructure, active participation in international projects and sustainable development initiatives, and the implementation of innovative teaching approaches. In addition, an analysis of digital platforms and tools was conducted, including programming languages (Python, Java, C++), the React library, frameworks (Angular, Django), and tools such as Jenkins and Kubernetes, which were used in teaching courses in programming, information security, databases, web development and Dev-Ops. The study also drew on the results of students' project activities, which involved the creation of IT products that took into account the principles of sustainable development, such as energy efficiency, environmental safety, social orientation, inclusivity and the responsible use of digital resources. The questionnaire was aimed at assessing the use of educational technologies and the development of professional competence in the context of sustainable development (Table 1).

**Table 1.** The study's questionnaire

No.	Question	Answer
1	Educational institution	a) National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute"; b) Kharkiv National University of Radio Electronics; c) Lviv Polytechnic National University; d) Oles Honchar Dnipro National University; e) Odesa Polytechnic National University
2	Year of study	a) 3 <sup>rd</sup> year of Bachelor's degree; b) 4 <sup>th</sup> year of Bachelor's degree; c) 1 <sup>st</sup> year of Master's degree; d) 2 <sup>nd</sup> year of Master's degree
3	Which platforms did you use during your studies? (may select more than one)	a) Moodle; b) Google Classroom; c) Microsoft Teams; d) Coursera/edX; e) GitHub; f) Docker; g) AWS Educate; h) Cisco Networking Academy; i) Other
4	How effectively did these platforms contribute to the acquisition of professional skills?	a) Very effective; b) Rather effective; c) Neutral; d) Rather ineffective; e) Completely ineffective
5	Did you participate in projects related to the principles of sustainable development (energy efficiency, inclusivity, digital ethics, etc.)?	a) Yes; b) No
6	How often were practical tasks with real-life cases used during your studies?	a) Constantly; b) Often; c) Sometimes; d) Rarely; e) Never

Table 1. Continued

No.	Question	Answer
7	Assess your level of preparedness for working in an IT speciality after completing the training courses (on a scale from 1 to 5)	a) 1 – Very low; b) 2 – Low; c) 3 – Average; d) 4 – High; e) 5 – Very high
8	Which digital tools do you think have contributed most to your professional development? (open-ended question)	

**Source:** compiled by the author

Descriptive statistics were used for the analysis to examine the frequency of use of technologies such as GitHub, Docker, Jira, Moodle, Google Classroom, Microsoft Teams, as well as AWS Educate and Cisco Networking Academy virtual labs. A comparative analysis of the effectiveness of these tools in the learning process was carried out by evaluating the results of student projects and participants' self-reports on the level of professional skills acquisition. In addition, an expert survey was conducted among lecturers who actively implemented modern teaching technologies, including simulation environments, Coursera and edX online certification courses, gamification through Codewars, and the integration of CI/CD environments for DevOps practice. This made it possible to determine which technologies contributed to the formation of key professional competencies, such as working with cloud services, process automation, team development, and adapting projects to environmental and social challenges. The questionnaire included the following questions:

1. What specific digital technologies have you implemented in your educational practice over the past two years?
2. How do you assess the effectiveness of using simulation environments in training IT specialists?
3. Have your students taken online certification courses (e.g., Cisco, AWS, Coursera)? What were the results?
4. What advantages and limitations did you observe when implementing these tools in the learning process?
5. How has the use of digital platforms influenced the development of critical thinking, teamwork, and project activities among students?
6. Were the principles of sustainable development taken into account when developing or selecting educational projects and technologies? If so, how exactly?
7. What changes do you consider necessary for the further improvement of the digital training of future IT specialists?
8. How do you assess the level of digital competence of your colleagues and students in the context of the new challenges of higher education?

In addition, contemporary educational approaches were characterised, in particular the use of gamification, the updating of educational programmes to take into account the challenges of digitalisation, the introduction of virtual internships, and the role of organisational culture in shaping the professional identity of future IT specialists. The research was conducted in accordance with the provisions

of the American Sociological Association's (1997). Ethical standards and principles of confidentiality were observed.

## RESULTS

### Analysis of digital platforms and tools in the training of future IT specialists

In the field of F "Information Technology" and F1-F7, the main aspects of popular technologies and platforms such as Python, Java, C++, and web development frameworks, including React, Angular, and Django, were studied. Python was studied as a universal programming tool, particularly in the fields of data analysis, machine learning, and web application development, due to its simplicity and numerous libraries that simplify software development. However, while studying Python, it was noted that one of its limitations is its slower execution speed compared to other languages such as C++. Java was studied as a language for creating scalable enterprise solutions, particularly in the financial and banking sectors, but its complexity for beginners was also noted as one of its drawbacks. The study of C++ covered its use for developing high-performance applications where execution speed is a critical factor. In addition, programming with React, Angular, and Django frameworks was included for developing modern web applications, with an emphasis on their effectiveness in creating interactive and dynamic user interfaces. Other important tools are DevOps platforms, including Jenkins, Docker, and Kubernetes. Using these tools allows for the automation of software deployment processes, which is important for modern development methods such as Continuous Integration (CI) and Continuous Delivery (CD). One of the main advantages is the simplification of environment management and improved development efficiency. However, significant technical training is required to use these tools effectively. Technologies for ensuring information security, such as encryption, firewalls, authentication systems, and security protocols such as HTTPS and SSL, are also widely used in educational programmes. These technologies are necessary to ensure data protection and combat cyber threats. However, their implementation requires a deep understanding of security theory and technical expertise, which can be challenging for students without relevant experience.

In particular, digital technologies such as Moodle allow for convenient course organisation, assignment delivery, and student performance monitoring. Teams and Google Classroom are used for interactive communication

between students and lecturers, organising video conferences and collaborating on projects. During project activities, students create IT products, taking into account the principles of sustainable development, such as energy efficiency, environmental safety and social orientation. For example, students develop web applications using green technology principles that reduce energy consumption, or create inclusive solutions accessible to people with disabilities. This prepares future IT professionals for real-world market conditions and promotes the implementation of sustainable development principles in the IT industry. Despite the many positive aspects, there are also drawbacks, in particular the need to update teaching materials and incorporate the latest tools. Lecturers and students often face difficulties in adapting to rapid changes in technology, which requires constant updating of curricula and resources. Thus, it is important to continue integrating the latest international practices and to provide universities

with the necessary infrastructural and technical resources for the implementation of innovative teaching methods.

### The impact of educational technologies on the formation of professional competence of future IT specialists in the context of sustainable development

The study revealed differences in the level of use of digital educational technologies among students of technical specialities. Analysis of the responses received made it possible to identify the main digital platforms and tools most frequently used during the learning process, as well as to assess their impact on the development of students' professional competence. A significant proportion of participants noted the effectiveness of digital platforms in mastering the course material and confirmed their participation in project activities that integrate the principles of sustainable development. Table 2 presents the summarised quantitative results of the survey.

**Table 2.** Results of the assessment of the use of digital technologies and the formation of professional competence in the context of sustainable development

Question	Answer options	Number of people
Educational institution	National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute"	75
	Kharkiv National University of Radio Electronics	64
	Lviv Polytechnic National University	61
	Oles Honchar Dnipro National University	58
	Odesa Polytechnic National University	54
Year of study	3 <sup>rd</sup> year of Bachelor's degree	118
	4 <sup>th</sup> year of Bachelor's degree	95
	1 <sup>st</sup> year of Master's degree	62
	2 <sup>nd</sup> year of Master's degree	37
Which platforms did you use during your studies? (may select more than one)	Moodle	245
	Google Classroom	212
	Microsoft Teams	185
	Coursera / edX	167
	GitHub	203
	Docker	129
	AWS Educate	91
	Cisco Networking Academy	114
	Other	48
	How effectively did these platforms contribute to the acquisition of professional skills?	Very effective
Rather effective		142
Neutral		48
Rather ineffective		23
Completely ineffective		10
Did you participate in projects related to the principles of sustainable development?	Yes	176
	No	136
How often were practical tasks with real-life cases used during your studies?	Constantly	72
	Often	125
	Sometimes	74
	Rarely	32
	Never	9
Assess your level of preparedness for working in an IT speciality after completing the training courses (on a scale from 1 to 5)	1 – Very low	5
	2 – Low	17
	3 – Average	83
	4 – High	128
	5 – Very high	79

Source: compiled by the author

The data obtained from the survey indicates the widespread implementation of digital educational platforms in the training process for students. Respondents most often cited the use of the Moodle platform (78.5%), which is explained by its versatility, integration into university courses, the ability to organise feedback and effective knowledge control. A significant percentage of students also noted Google Classroom (67.9%) as a convenient tool for communication, access to learning materials, and assessment. This indicates a combination of formal and cloud-based learning environments. Equally important was the widespread use of GitHub (65%), which indicates an emphasis in training programmes on teamwork, version control, and a portfolio approach to project activities. Microsoft Teams, chosen by 59.3% of respondents, indicates the active implementation of integrated solutions for distance and hybrid learning, particularly in the context of pandemic restrictions. It is important to note that more than half of the students (53.5%) used Coursera or edX, demonstrating an interest in acquiring additional knowledge outside of university programmes and a willingness to engage in self-education in a globalised educational environment. Participation in massive open online courses is an indicator of students' desire to expand their competence and focus on interdisciplinarity. Specialised platforms and environments focused on engineering and professional practices constitute a separate category: Docker (41.3%) indicates familiarity with containerisation as part of the DevOps approach, while Cisco Networking Academy (36.5%) indicates that some students are focused on studying computer networks, information security, and certification programmes. The AWS Educate\*\* platform, used by 29.2% of respondents, demonstrates the integration of cloud services into the learning process, which is in line with current trends in IT specialist training. An assessment of the effectiveness of these digital platforms showed that 74% of students consider them to be at least effective in acquiring professional skills (28.5% – “very effective”, 45.5% – “rather effective”). Only 8% of respondents consider these tools ineffective (6.7% – “rather ineffective” and 1.3% – “completely ineffective”), which may indicate either shortcomings in the implementation of individual tools or an uneven level of digital literacy among students. At the same time, 17.9% of respondents took a neutral position, indicating the need for further analysis of the factors that influence subjective assessment of effectiveness.

An analysis of participation in projects related to the principles of sustainable development showed that 56.4% of students had such experience. This indicates the gradual introduction of value-oriented approaches in the professional training of IT specialists, in particular an emphasis on social responsibility, ethical use of digital resources, energy efficiency, inclusiveness and cybersecurity. Such integration of sustainable development principles into the educational process contributes to the formation of a holistic professional worldview among students who are capable of responding to the challenges of modern

society. Regarding the use of practical tasks with real-life cases, over 63% of respondents indicated that such tasks are used constantly (25.6%) or frequently (37.5%). This is evidence of the widespread implementation of project-based learning as a means of acquiring competencies closely related to the conditions of real production practice. Only 13.5% of participants reported rare or no use of real-life cases, indicating a certain unevenness in the practical component in different curricula or disciplines. The final part of the closed-ended questions in the questionnaire involved self-assessment of the level of readiness to work in the profession. Here, a high level of subjective confidence in one's own knowledge and skills can be observed: 66.3% of respondents rated their readiness as “high” (41%) and “very high” (25.3%). Another 24.7% indicated an average level, which may indicate a need for further professional support or additional practical experience. Only 9% of students rated their level of preparation as low or very low, which indicates the overall positive impact of educational programmes on the formation of readiness for professional activity in the IT sphere.

Analysis of responses to the open-ended question “Which digital tools do you think have contributed most to your professional development?” revealed a wide range of digital tools that respondents believed had contributed most to their professional development. The most frequently mentioned tools were GitHub, Visual Studio Code, Figma, Docker, Jupyter Notebook, as well as cloud platforms such as AWS, Google Cloud Platform, and Firebase. Some students highlighted Notion and Trello as effective tools for planning, organising teamwork, and project management. A significant number of responses contained references to online courses and self-learning environments, including Coursera, edX, and Udemy, indicating the important role of informal learning in the formation of key digital competencies. This also confirms the trend towards the individualisation of educational trajectories and a high level of self-organisation among students. Respondents' answers also mentioned specialised tools such as Postman (API testing), Kubernetes (container orchestration), TensorFlow and PyTorch (artificial intelligence and machine learning), which indicates the depth of student engagement in modern IT development fields. Several students noted the importance of integrated development environments such as IntelliJ IDEA, PyCharm, Eclipse, as well as the use of GitLab CI/CD for automating application deployment and version control, which was particularly valued in project or course programming.

The survey results show a high level of use of digital platforms in the learning process, which correlates with an increase in the effectiveness of professional knowledge acquisition. Analysis of open-ended responses showed that students use a wide range of digital tools not only as part of the learning process, but also for self-education and practical professional growth. Most of them prefer tools that allow them to implement the full cycle of project activities: from development, testing and documentation to

automation, teamwork and presentation of results. This indicates a high level of student motivation to master the digital environment and a desire for adaptive professional development. The results of a comparative analysis of the effectiveness of digital tools in the learning process showed

that the use of GitHub, Docker, Cisco Packet Tracer, and AWS has a positive impact on the level of acquisition of practical skills related to software development, containerisation, infrastructure management, cloud services, and network configurations (Table 3).

**Table 3.** Comparative characteristics of digital tools in the training of future IT specialists

Digital tool	Main purpose	Level of use by students	Effectiveness assessment (based on project results and self-reports)	Characteristics
Moodle	Learning Management System (LMS)	High	Moderate effectiveness in theoretical training	Convenient for organising the learning process, but limited in terms of developing practical skills
Google Classroom	LMS for lecturer-student interaction	High	Moderate effectiveness	Facilitates communication and access to materials, but is not focused on practical IT tasks
Microsoft Teams	Platform for collaboration and video conferencing	High	Average effectiveness	Useful for team interaction, but limited in terms of professional training
GitHub	Service for developing, storing, and sharing code	High	High effectiveness	Develops skills in team development, version control, and collaborative work on program code
Docker	Platform for deploying containerised applications	Average	High effectiveness	Promotes practical understanding of DevOps principles, software deployment and testing
AWS Educate	Virtual environment for learning cloud technologies	Low	High effectiveness in narrow specialisation	Develops practical skills in working with cloud infrastructures, but requires technical training
Cisco Networking Academy	Educational platform for studying computer networks	Average	High effectiveness	Provides in-depth knowledge of network technologies, actively used for certification
Jira	Project management tool	Low	Average effectiveness	Useful for learning Agile methodologies, but requires coordination of teamwork

**Source:** compiled by the author

Students who used these environments in their project work demonstrated high performance in terms of practical training, independence, technical literacy, and the ability to solve applied problems. These results are also confirmed by the content of self-reports, in which respondents noted that working with these platforms contributed to a deeper understanding of technological processes close to the real production environment, increased confidence in their professional competencies, and increased motivation to learn. At the same time, traditional educational platforms, such as Moodle, Google Classroom, and Microsoft Teams, played an important

role in organising the learning process, ensuring communication between lecturers and students, and providing access to learning materials and assignments. However, their impact on the development of practical skills could be limited, so students used other tools as well. Although traditional platforms provide the organisational component of the educational process, the use of specialised simulation and production-oriented digital environments is necessary for the formation of deep professional competencies. The collected data helped to analyse current trends and identify opportunities for further improvement of the learning process (Table 4).

**Table 4.** Summary of interviews with lecturers on the use of digital technologies in training IT specialists

Question	Key responses	Number of mentions
What specific digital technologies have you implemented in your educational practice over the past two years? (may select multiple options)	Moodle	20
	Microsoft Teams	18
	GitHub, Docker	22
	Cisco Packet Tracer	11
	AWS	14
	Miro	9
	Zoom	5

Table 4. Continued

Question	Key responses	Number of mentions
How would you assess the effectiveness of simulation environments in training IT specialists?	High effectiveness in developing practical skills, particularly in networking, security and DevOps; limitations include students' level of technical preparation and unstable access to resources.	"High effectiveness" – 19
		"Limited effectiveness" – 7
		"Has limitations" – 2
Have your students taken online certification courses (e.g., Cisco, AWS, Coursera)? What were the results?	Yes, they are actively used (Cisco, Coursera, AWS, Google); this has led to improved skills, increased motivation and enhanced competitiveness.	Cisco – 18
		Coursera – 20
		AWS – 10
		Google – 6
What advantages and limitations did you observe when implementing these tools in the learning process?	Advantages: flexibility, interactivity, access to global content; limitations: unstable internet connection, workload, digital inequality.	Advantages mentioned – 28
		Limitations – 24
How has the use of digital platforms influenced the development of critical thinking, teamwork, and project activities among students?	The development of project-based thinking, critical analysis and collaboration was noted through the use of team platforms and joint work on case studies.	Critical thinking – 21
		Teamwork – 23
		Project-based activity – 25
Were the principles of sustainable development taken into account when developing or selecting educational projects and technologies? If so, how exactly?	Yes, within project topics (environmental IT solutions, inclusive interfaces, ethical programming); individual cases were integrated into training courses.	Yes – 17
		Partially – 6
		No – 5
What changes do you consider necessary for the further improvement of digital training for future IT specialists?	The need to improve lecturers' digital competence, develop IT infrastructure, integrate certification programmes, and prepare open simulation-based case studies.	Improvement of digital skills – 22
		Infrastructure – 18
		Certifications – 12
How do you assess the level of digital competence of your colleagues and students in the context of the new challenges facing higher education?	Students: a high but fragmented level, requiring better structuring of knowledge. Colleagues: varying levels, with a need for professional development.	Students – "adequate" – 20
		Colleagues – "mixed levels" – 24

Source: compiled by the author

The analysis of interviews revealed that lecturers actively implement various digital tools, including both traditional learning management platforms and specialised environments that simulate professional situations. This demonstrates a desire to integrate the learning process with practice that is close to the real IT environment. Lecturers consider the use of simulation environments to be an effective approach that allows students to develop not only technical but also analytical skills. These tools contribute to the formation of competencies that are relevant for solving applied problems in the field of IT. At the same time, some difficulties have been identified related to individual barriers for students in working with simulation tools. A significant proportion of lecturers note that online certification courses have become an important addition to educational programmes, providing students with access to the latest knowledge and increasing their competitiveness. This has also created additional opportunities for forming interdisciplinary connections and independent mastery of the material.

Analysis of the responses showed that digital platforms generally have a positive impact on the development of critical thinking skills, teamwork, and the implementation of educational projects. At the same time, attention

is drawn to existing limitations: uneven access to digital resources, platform overload, and the need for methodological support. The issue of integrating sustainable development principles is considered through the prism of the content of educational projects: from environmental awareness to ethical use of data. Lecturers noted that sustainable development topics are increasingly finding their way into technical education and require a rethinking of teaching methods. When assessing the digital competence of students and colleagues, most respondents noted positive dynamics, although they drew attention to the need for systematic development of digital skills at all levels. Among the strategic changes required by the system are infrastructure improvements, lecturers training, and the integration of digital resources into curricula, taking into account global challenges.

#### Recommendations for developing the professional competence of future IT specialists in the context of sustainable development

Based on the analysis of educational practice and current trends in the field of information technology, a set of recommendations for developing the professional competence

of future IT specialists in the context of sustainable development has been identified. In particular, modern IT companies such as Microsoft, Google, IBM, Accenture and SAP place requirements on graduates that go beyond deep technical knowledge, including proficiency in programming languages, databases, cloud technologies and infrastructure management, and also emphasise the importance of critical thinking, teamwork and lifelong learning. They additionally expect candidates to demonstrate ethical responsibility, problem-solving abilities and an understanding of the environmental implications of technological activity. Requirements for professional training highlight, in particular, the need for knowledge in the areas of software development, infrastructure, IT service management and security assurance. The IEEE standard defines a body of knowledge and practices for software developers, covering the stages of development, testing, maintenance and improvement of products, which help to achieve high software quality. The ITIL standard defines methods of IT service management aimed at improving the efficiency and quality of services provided to users, including the implementation of best practices in incident, problem and change management, as well as service continuity management.

It is recommended to integrate the use of modern educational platforms into the training of IT specialists, such as Cisco Networking Academy, Microsoft Learn, IBM Skills-Build and Google Cloud Skills Boost, which offer applied courses with an emphasis on the safe and ethical use of IT solutions. Particular attention should be paid to mastering tools for developing energy-efficient code, designing socially oriented applications, and understanding the principles of “green” IT infrastructure. Innovative approaches include incorporating simulations of sustainable projects into curricula, analysing the software life cycle, developing environmentally sensitive IT products, and using big data and artificial intelligence to address sustainable development challenges. All of these measures contribute to developing students’ systemic understanding of the role of IT in a sustainable future and ensure that specialist training meets the needs of the modern labour market. For Ukrainian universities seeking to enhance the training of future IT specialists in the context of sustainable development, it is important to take into account global educational trends and innovations. One of the key recommendations is the active adoption of international experience in the use of advanced educational technologies, such as artificial intelligence (AI) and gamification. Artificial intelligence, particularly in the context of personalised learning, can be implemented to create adaptive learning platforms that take into account individual students’ needs, levels of knowledge and learning styles. Examples include platforms such as Coursera and edX, which use AI algorithms to recommend courses and analyse learner performance, adapting educational content accordingly.

Another recommendation is the integration of gamification elements into educational programmes in order to increase student motivation and engagement. An

example of this approach is the use of platforms such as CodeCombat, which apply gamification to the learning of programming languages and foreign languages. Modern teaching methods that incorporate elements of gamification provide students with opportunities to master courses in an interactive and engaging format, where they can earn points, progress to higher levels and receive real-time feedback. For example, when learning programming, a student completes a series of practical tasks and receives virtual rewards for successful completion, which increases learning motivation. At the same time, the training of future specialists in the field of information technology requires updating the content of educational programmes by introducing new modules devoted to relevant topics such as cybersecurity, the ethics of artificial intelligence and big data analytics. This is particularly important in the context of rapid technological development and the growing need to ensure data security. For instance, a course on AI ethics may include the analysis of cases of algorithmic discrimination and discussions of the principles of transparency and accountability in the development of automated solutions. Such educational components help students not only to acquire technical knowledge but also to develop an understanding of the ethical, legal and social aspects of working with modern digital technologies.

In addition, the introduction of virtual internships as a form of professional training is becoming an important innovation in the educational process, allowing students to gain practical experience without leaving their educational institution or home. For example, a student specialising in “information systems” may participate in a virtual internship at an international software development company, performing real tasks through a specialised platform that ensures communication with mentors and monitoring of task completion. Such internships make it possible to become familiar with the specifics of work in various IT fields, business and science, and to develop skills that are critical for a modern specialist, including self-organisation, critical thinking and effective teamwork. At the same time, a flexible schedule and the absence of the need for physical presence allow students to combine study with other activities. Moreover, virtual internships create opportunities for participation in international projects, thereby broadening students’ professional horizons.

An important component of effective training for IT specialists is also consideration of the role of organisational culture in shaping their professional identity. Organisational culture – the set of values, norms, traditions and styles of interaction within a collective – contributes to awareness of one’s professional role, the formation of ethical principles and the development of the ability to work effectively in a team. For example, when participating in a joint project within a company that supports openness and mutual assistance, a student learns not only to perform technical tasks but also to value shared responsibility, respect for colleagues and the importance of feedback. Through engagement in real tasks, the use of corporate

standards, participation in training sessions and joint initiatives, young specialists are gradually integrated into the professional environment, which influences their readiness to make decisions, implement innovations and adapt to change. In this way, organisational culture becomes an integral factor in shaping a well-rounded professional who is capable not only of working with technologies but also of acting responsibly within social and professional contexts. To integrate these innovative approaches, universities can cooperate with international educational platforms, involve foreign experts in curriculum development, and adapt advanced teaching methodologies to the Ukrainian context. Drawing on international experience will enable Ukrainian universities not only to improve the quality of education but also to make the training of IT specialists more closely aligned with the requirements of the modern labour market, which in turn will contribute to the country's sustainable development and the integration of its economy into the global space.

## DISCUSSION

The results of this study showed that the use of digital technologies, in particular cloud platforms, interactive learning management systems, and massive open online courses, can contribute to the development of professional competence of future IT specialists. This approach ensures the accessibility of knowledge, flexibility in learning, and adaptability to the individual educational needs of students. These conclusions are consistent with the results of the study by O. Popelo *et al.* (2024), who pointed to a global trend towards the digitalisation of universities in the context of sustainable development, where information technology is a key tool for the modernisation of education. This study found that IT students demonstrate high motivation to learn in a digital environment, especially when project-based learning elements are present. This correlates with the conclusions of M. Ramírez-Montoya *et al.* (2021) and H. Tin as (2022), who determined that future educational programmes should focus on the development of self-organisation, interdisciplinarity and emotional intelligence skills, which can be achieved through the integration of innovative technologies. It is important to note that the effective use of educational technologies also promotes inclusiveness and consideration of different learning styles. The results of this study confirmed that students successfully assimilate material through multimedia content, simulations and visualisations. The same conclusions are reflected in the study by S. Rodríguez-Cano *et al.* (2022), which states that learning support technologies have a positive impact on the ability of students with specific learning difficulties to achieve professional competence. This is partly consistent with the findings of S. Hyrynsalmi (2024), who emphasised the need to create favourable conditions for women returning to the IT sector, as this can significantly enrich the professional environment and increase innovation in the industry. This approach also fits in well with the concept proposed by M. Mawardi *et al.* (2024)

and Y. Meng *et al.* (2024), who studied the impact of digital technologies on the development of higher education. The researchers found that digital technologies improve the accessibility of education, increase the interactivity of learning, and contribute to the personalisation of the learning process for students.

An analysis of the effectiveness of massive open online courses in programming education showed positive dynamics in the formation of professional skills such as problem solving, teamwork, and independent learning. This is confirmed by the results of a study by S. Sharov *et al.* (2021), which states that MOOCs are a promising form of training for IT specialists due to their flexibility, accessibility, and adaptability to the needs of the labour market. Another result of this study is the identification of the need to update the content of educational programmes to take into account sustainable development and digital transformations. It was found that traditional disciplines should be supplemented with modules on cybersecurity, artificial intelligence ethics, and big data analysis. These results are consistent with the conclusions of H. Shi *et al.* (2024), who pointed to the need to revise information systems curricula towards modern technological and socially responsible areas. In addition, the use of innovative platforms for digital learning ensures an interactive learning process and creates conditions for flexible knowledge acquisition. M. Handrich & M. Otterbach (2024) also showed that the use of digital platforms for learning can significantly improve the effectiveness of knowledge and management in corporate IT systems, which has a positive impact on the training of future specialists, improving their adaptation to changes in the professional environment.

This correlates with the research of U. Stoltenberg and G. Michelsen (2023), who emphasised that sustainable development should be integrated into digital education as an integral part of training globally oriented specialists. In the context of the sustainable development of technologies for training future IT specialists, it is important to create learning environments that promote the development of professional competencies in line with the modern requirements of the digital economy. As demonstrated by the study of O. Korotun *et al.* (2020), models for the use of cloud technologies in teaching databases are effective in the training of IT specialists, as they provide opportunities for learning in an interactive and accessible format. These results were consistent with the findings of P. Fidalgo & J. Thormann (2024), who emphasised the importance of integrating artificial intelligence and distance learning into processes of continuous professional development. They argue that distance learning supported by new technologies makes it possible to ensure sustainable development in the field of IT specialist training, as students are able to acquire new knowledge without temporal or spatial limitations. Particular attention in the present study was paid to virtual internships, which demonstrated high effectiveness in the development of practical skills. This corresponds with the research of A. Tolentino & T. Palaoag (2022) and

Y. Wei (2024), who noted that models for predicting student performance in virtual internships help to improve the quality of training of future IT professionals.

Special attention should also be given to the importance of soft skills in the preparation of IT personnel. These findings correspond with the conclusions of G. Tomer & S. Mishra (2023), who established that career progression and job satisfaction among IT specialists directly depend on the level of development of their soft skills. The study also highlights the role of organisational culture in the formation of the professional identity of future IT specialists. M. Topuzovska Latkovikj *et al.* (2023) also considered the technological preferences of IT specialists in connection with organisational culture and corporate values. With regard to the implementation of flexible project management methodologies, this study showed that the use of innovative approaches in the educational process stimulates student initiative and increases the level of professional responsibility. This aligns with the findings of M. Neumann & L. Baumann (2022), who integrated professional Scrum training into university courses on IT project management and obtained positive results in the development of managerial competences.

An important component of professional competence formation is continuous professional development through participation in practice-oriented courses and training programmes. The present study found that students should have experience of participation in the activities of university computer centres in order to better adapt to the professional environment. This conclusion is consistent with the results of B. Zulauf & N. Knipprath (2020), who demonstrated the effectiveness of practical training in university IT centres as a foundation for the development of professional competence. Another component of the formation of professional competence among future IT specialists is practical training carried out through adherence to IT industry standards. As noted by A. Celestial-Valderama (2023), internship experience in IT companies is an important stage in the professional development of future IT specialists. The conclusions of this study also correspond with the findings of M. Chandrakala *et al.* (2024), who indicated that the effective use of learning and development data through HR analytics enables the creation of more accurate and personalised IT training programmes, thereby increasing the effectiveness of internships.

Particular attention should also be paid to the establishment of specialised research and training centres for the preparation of IT specialists, as proposed by S. Gulyamov *et al.* (2024) and X. Yuan (2024). They emphasised that such centres, which integrate innovative teaching methods and digital technologies, contribute to improving the quality of education and meet the requirements of sustainable development. This approach is also supported by the work of S. Jacobs & S. Jaschke (2023), which focuses on the use of large language models in the training of IT specialists. They noted that these models can be an important tool for developing new professional skills in conditions of constant

technological change. Overall, the results of this study confirm the thesis that effective training of future IT specialists in the context of sustainable development is possible only through the combination of advanced digital technologies, practice-oriented approaches and interdisciplinary integration. Thus, the consistency of the obtained results with the above-mentioned studies indicates the soundness of the chosen strategy for the formation of professional competence among future IT specialists.

## CONCLUSIONS

The study confirmed that the introduction of modern digital technologies has a positive impact on the professional competence of future IT specialists. Active use of platforms such as GitHub, Moodle, Cisco Networking Academy, and cloud tools contributes to the development of practical skills, critical thinking, and teamwork abilities. A significant proportion of students (76%) recognised these technologies as effective for professional growth. More than 65% of respondents participated in projects related to the principles of sustainable development, which indicates the integration of ethical and environmental components into technical training. Students also noted that online courses on the Coursera and edX platforms provide additional opportunities for in-depth study of the material and obtaining international certificates, which increases their competitiveness in the labour market.

A comparative analysis of digital tools shows that 56.4% of students had experience working with the latest tools. This indicates the gradual introduction of value-oriented approaches to the professional training of IT specialists, in particular an emphasis on social responsibility, ethical use of digital resources, energy efficiency, inclusiveness and cybersecurity. Such integration of sustainable development principles into the educational process contributes to the formation of a holistic professional worldview of students who are able to respond to the challenges of modern society. Regarding the use of practical tasks with real cases, more than 63% of respondents indicated that such tasks are used constantly (25.6%) or often (37.5%). This is evidence of the widespread implementation of project-based learning as a means of acquiring competencies closely related to the conditions of real production practice. Interviews with lecturers confirmed the trend towards the active implementation of digital technologies in the learning process. GitHub and Docker were the most popular, mentioned 22 times, accounting for 28.2% of the total number of responses.

Moodle and Microsoft Teams were used by 20 and 18 lecturers, respectively (25.6% and 23.1%), while other tools, such as Cisco Packet Tracer (11 mentions, 14.1%) and AWS (14 mentions, 17.9%), were less common. Regarding the effectiveness of simulation environments, 70.5% of lecturers indicated high effectiveness in developing practical skills, particularly in networking and security, although 14.1% noted limitations due to unstable access to resources and insufficient technical training of students. The process of

online certification, particularly through Cisco, Coursera, AWS, and Google, was actively used, with most mentions relating to Coursera (25.6%) and Cisco (23.1%). 79.5% of respondents recognised the advantages of digital tools, such as flexibility and access to global content, although 61.5% noted problems with internet connectivity and digital inequality. The study was limited by the small number of participants, which may not fully reflect the experience of all higher education institutions, as well as the predominantly self-reported nature of the responses, which may contain subjective assessments. Prospects for further research include expanding the sample of participants,

including students of different educational levels and specialisations, and conducting a comparative analysis between different countries.

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**Технології навчання та формування професійної компетентності майбутніх ІТ-фахівців у контексті сталого розвитку**

**Анотація.** Метою дослідження було вивчення інструментів і технологій, що використовуються у освітніх програмах провідних технічних університетів України для підготовки майбутніх ІТ-фахівців. Методологія дослідження включала анкетування 312 здобувачів освіти та 28 викладачів, аналіз цифрових платформ і технологій, а також порівняльний аналіз ефективності використаних інструментів для формування професійної компетентності майбутніх ІТ-фахівців у контексті сталого розвитку. У дослідженні було вивчено вплив сучасних цифрових технологій на формування професійної компетентності майбутніх ІТ-фахівців. Активне використання таких платформ, як GitHub, Moodle, Cisco Networking Academy та хмарні інструменти, підтвердило позитивний вплив на розвиток практичних навичок і критичного мислення. У дослідженні було визначено, що 89 студентів визнали ці технології ефективними для професійного зростання. Більше 176 респондентів брали участь у проектах, що включають принципи сталого розвитку, що свідчить про інтеграцію екологічних і етичних аспектів у навчальний процес. Також 167 студентів відзначили ефективність онлайн-курсів на платформі Coursera та edX для поглибленого вивчення матеріалу, що підвищує їх конкурентоспроможність. Аналіз результатів показав, що сервіси на кшталт GitHub, Docker, AWS Educate та Cisco Networking Academy відіграють ключову роль у формуванні практичних, проектно орієнтованих навичок. Натомість інструменти організації навчального процесу – такі як Moodle та Microsoft Teams – мають інше функціональне призначення й використовуються передусім для комунікації, управління навчальними матеріалами та підтримки освітнього середовища, а не для розвитку прикладних технічних компетентностей. Практичне значення роботи полягає у тому, що її можуть використовувати викладачі, освітні установи та розробники навчальних програм для вдосконалення процесу підготовки ІТ-фахівців, інтегруючи сучасні цифрові інструменти та технології у навчальний процес з урахуванням принципів сталого розвитку

**Ключові слова:** освітній процес; підготовка фахівців; інноваційні технології; процес програмування; практичні навички

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## Patriotic education as a factor of professional identity of a future specialist

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**Abstract.** The purpose of the study was to determine the effectiveness of applying innovative pedagogical approaches and educational measures in the development of professional identity and national and patriotic values among students. The study methodology included a comprehensive approach that combined theoretical analysis, pedagogical experiment, and development of the author's model of educational work. During the experiment, it was determined that the use of digital platforms and mobile applications, such as “Mriya”, “Can't Wait to Learn: Ukraine” and “Ukraine without borders”, provided interactivity of learning, development of critical thinking, analytical skills, and digital competencies of students, in addition to the stimulated independent work and team interaction. The results of the study showed that the level of formation of patriotic education as a factor of professional identity of students of the experimental group increased more actively than in the control group. Within three months, the activity of students in the experimental group increased from 60% to 70%, the level of professional identity increased from 61.7% to 77.3%, and civic consciousness – from 59.3% to 75.7%. Academic results and activity in projects established positive dynamics – 88% and 81%, respectively. In the control group, the improvement was insignificant and less pronounced, which indicates a limited effectiveness of traditional training methods. Thus, the integration of innovative technologies, mobile platforms, interactive forms of work, and project activities has confirmed its effectiveness in the formation of patriotic values, increasing civic activity, and strengthening the professional identity of future specialists. The practical importance of the study lies in the fact that its results can be used by teachers, methodologists, heads of educational programmes, and administrations of higher educational institutions to implement effective strategies for patriotic education and the development of students' professional identity

**Keywords:** civil responsibility; moral values; professional consciousness; national identity; personal development

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## INTRODUCTION

Patriotic education is the basis for the formation of value orientations and professional consciousness of the future specialist, directing their development to awareness of the social mission of the chosen profession. It creates a sense of responsibility for the results of work, a willingness to act in the interests of the state and society, and supports the stability of moral beliefs in professional activities. Through a system of educational and upbringing influences, patriotic education ensures the integration of civic, ethical, and professional values, creating a foundation for

self-determination in the professional environment. This approach contributes to the development of a specialist who is able to combine professional competence with spiritual and civic qualities, which strengthens the integrity of their identity.

Patriotic education in the process of forming the professional identity of a future specialist has been examined by various authors. For example, M. Bagriy (2024) highlighted conceptual approaches to the formation of civic consciousness and patriotism among students, proving that the



combination of national values with professional competencies contributed to the awareness of social responsibility of future specialists. The author analysed both Ukrainian and international experience, showing that the development of patriotic attitudes in professional education formed not only moral but also professional guidelines. S. Batool & S. Ghayas (2020) concentrated on the components of career identity formation in adolescents, where the importance of the social and cultural environment was emphasised. The authors have proven that professional identity is formed under the influence of values, including patriotic attitudes, enabling the effective integration of personal and professional goals. Z. Huang *et al.* (2023) analysed national identity through digital media, proving that patriotism and nationalism were formed as components of local and professional identity. Their results showed that awareness of nationality has a direct impact on acceptance of social roles and professional responsibilities. Such conclusions coincide with the positions of M. Matthews *et al.* (2024), which demonstrated that organisational patriotism contributes to the formation of professional loyalty and ethical standards in the work environment. The study showed that awareness of patriotic values increases motivation to actively participate in collective professional processes and strengthens the sense of responsibility for the overall result.

Similar results at the pedagogical level were obtained by V. Myroshnychenko *et al.* (2024), who, within the framework of the programme “Protection of Ukraine” demonstrated that training modules on patriotic education contribute to the formation of professional responsibility of future teachers. The study demonstrated that the active inclusion of patriotic values in the educational process increases students’ motivation for professional self-improvement and the development of critical thinking in the field of teaching. S. Yakimenko *et al.* (2021) reviewed the training of future specialists for civic education of preschool children, proving that patriotic competencies are formed in close connection with professional training. Their results confirmed the conclusions of F. Mavlonov (2022) on the importance of the practical component in the development of professional identity. It is established that the direct application of patriotic competencies in professional activities contributes to the consolidation of moral and value orientations, which ensures the stability of professional self-determination of future specialists. The professional identity of military instructors of the South African Armed Forces was analysed by W. Wagner *et al.* (2021), demonstrating that patriotic values are an integral part of professional development and moral motivation. This confirmed the universality of the principle of combining patriotism and professional competencies in various fields of activity. K. Wong *et al.* (2021) proposed a model of national and moral education in Hong Kong, showing that the formation of patriotic attitudes among future teachers contributes to the strengthening of professional identity. The results of their work correlate with studies by E. Vickers (2024), which examined the impact of public policy on

the national identity of schoolchildren in Hong Kong. The author proved that public narratives and patriotic education have a direct impact on professional self-determination in the educational sphere.

Despite the aspects highlighted by the above-mentioned authors, the gaps include insufficient review of the mechanisms of influence of patriotic education on the development of specific professional competencies in various fields of activity. There are few publications left that analyse the long-term effect of integrating patriotic values into the formation of professional identity of future specialists. There is a lack of comparative studies between different educational programmes and countries that can reveal universal and local patterns of this process. Insufficient attention is paid to the role of individual psychological characteristics of students in the assimilation of patriotic competencies and their impact on professional development. The study aimed to examine the influence of innovative teaching methods and educational work on the formation of professional identity and national-patriotic competence of students. The objectives of the study were to analyse innovative digital tools in the formation of professional identity and national-patriotic competence of educational applicants; assess the level of patriotic education and professional identity of students; form an author’s model of educational work for the formation of professional identity and national-patriotic competence of educational applicants.

## MATERIALS AND METHODS

In the process of studying the influence of patriotic education on the professional development of applicants for education at the National Technical University of Ukraine “Igor Sikorsky Kyiv Polytechnic Institute”, an integrated approach was chosen, combining the use of innovative programmes, conducting a pedagogical experiment and developing a model of educational work. At the first stage, key terms such as “patriotic education”, “professional identity”, “civic consciousness”, “value orientation”, and “national-patriotic competence” were considered based on N. Spielmann *et al.* (2020), O. Prytula (2023), which provided a clarification of the content and specifics of patriotic education and its connection with the professional self-realisation of students. Through the study by A. Maksiutov & V. Honcharuk (2023), V. Bogouta (2024), Ministry of Youth and Sports of Ukraine (2024) analysed the concepts of value approach, integrated learning and activity approach, which focused on internal motivation, combining professional knowledge with the patriotic component and active participation of students in scientific and practical, volunteer and cultural and educational projects, along with the practical components through participation in projects, development of initiatives, presentations, excursions and volunteer programmes, supplemented by interactive work with mobile applications and digital platforms. The applications “Mriya” (“Mriya” modernises school..., 2024) and “Can’t Wait to Learn: Ukraine” (New app to bring education..., n.d.) and “Ukraine without borders” (Ukraine

unlimited learning, n.d.), which were analysed on the basis of interactivity criteria, the availability of educational content with a national-patriotic component, the ability to track students' progress, and support the development of critical thinking and motivation for independent learning. These tools were chosen to provide interactive assimilation of the material, develop critical thinking, and motivation to independently study national history and achievements in technology and science.

At the second stage, a pedagogical experiment was conducted with the participation of 68 students of technical and engineering specialities of the University. The inclusion criteria were Bachelor's and Master's degree programmes, no academic debt, and voluntary consent to participate in the project. The exclusion criteria were no regular participation in the learning process or incomplete testing. Students were divided into two groups in a 1:1 ratio: an experimental group that worked with mobile applications and innovative programmes, and a control group that underwent traditional training. For three months (March-May 2025), the participants of the experimental group were consistently introduced to innovative methods aimed at developing patriotic education and forming a professional identity. Students participated in interactive training modules that combined theoretical knowledge with practical tasks aimed at studying the history of Ukraine, the achievements of Ukrainian scientists and cultural heritage. They worked on integrated cases and projects that combined technical and professional skills with research on national and historical topics, creating presentations, analytical reports, and visualisations. Mobile applications such as "Mriya", "Can't Wait to Learn: Ukraine" and "Ukraine without borders" were used to consolidate the material, which allowed passing interactive tests, completing quests, and receiving real-time feedback.

In addition, students were involved in scientific and practical laboratories, thematic discussions and round tables, where they discussed social and cultural issues related to national identity, and developed their own initiatives. Considerable attention was paid to cultural, educational, and volunteer activities, including excursions to historical and cultural sites, master classes on Ukrainian crafts, participation in charitable and public projects, which contributed to the development of the emotional and value component of patriotic consciousness. Self-assessment and mutual assessment methods were employed in group tasks to encourage independent activity and critical thinking, enabling students to recognise their own achievements and take responsibility for working together. Such a comprehensive application of innovative methods allows both to deepen professional knowledge and develop a civic position, patriotic consciousness, and active participation in the life of the university and public community, ensuring the systematic development of both professional and value-oriented identity of students. The results of the experimental and control groups were evaluated using standardised quantitative and qualitative methods, including the

use of the Professional Identity Scale (Woo, 2013) of the Civic Engagement Scale (Remr, 2023). Academic achievements were recorded through grades for academic disciplines and completed integrated assignments. In addition, students of the experimental group underwent self-assessment and mutual assessment within group tasks, which determined the level of responsibility, activity, and team interaction. Data from all instruments were subjected to statistical processing by the student, with a comparison of average values between groups, enabling the quantification of the effectiveness of the implemented innovative methods and determining their impact on the formation of professional identity and patriotic values of students. The experiment was conducted in compliance with the ethical principles and confidentiality requirements provided by World Health Association (1964), ensuring students' voluntary participation, personal data protection, and informed consent to take part in the study.

In the third stage, a model of educational work was developed, which included the following steps: selection and integration of thematic courses and modules with a patriotic component in the curriculum, introduction of scientific and practical projects and research tasks that combined professional competencies with a civic position, organisation of cultural and educational events and volunteer initiatives to form an emotional and value component of identity and implementation of a systematic assessment of effectiveness, which included analysis of academic achievements, activity in projects, and results of student questionnaires. In particular, practical recommendations were given for applying the model.

## RESULTS

### **Innovative digital tools in the formation of professional identity and national-patriotic competence of educational applicants**

The term "patriotic education" covers a system of measures, methods and practices aimed at forming students' sense of responsibility for the fate of the state, respect for national history, culture, and achievements of science and technology. Specifically, professional identity, which is associated with patriotic education, determines the student's awareness of their role in professional activities, a combination of knowledge, skills and value orientations, which allows them to effectively implement their competencies and make responsible decisions in the field of their future profession (Spielmann *et al.*, 2020). Civic consciousness implies the student's understanding of their rights and obligations, the ability to actively participate in the social and cultural life of society, to critically evaluate social processes, and form their own position on them. Value orientation reflects a system of priorities that determines the behaviour and motivation of students in professional and civic activities, including respect for traditions, ethical norms, readiness for self-improvement and lifelong learning. National-patriotic competence integrates knowledge, skills and value orientations that ensure effective interaction of

the student with the national and professional environment, the ability to critically analyse the national history and development of the country, along with active participation in social and professional processes (Maksiutov & Honcharuk, 2023). The relationship between these terms is manifested in the fact that patriotic education forms the basis for the development of civic consciousness and value orientation, which, in turn, affects the student's awareness of their professional role and the development of professional identity. For example, the integration of national historical content into technical courses helps students simultaneously assimilate professional knowledge and realise the importance of their future activities for the development of the state. The implementation of scientific-practical projects with national-patriotic content stimulates the development of national-patriotic competence, teamwork skills, organisational abilities, and critical thinking, contributing to the awareness of social responsibility.

Value orientations and civic consciousness are realised through students' participation in cultural and educational events, volunteer programmes, and thematic discussions. For example, participation in events dedicated to the history of Ukrainian science and technology, or in

projects to restore the national heritage, motivates students to combine educational and upbringing activities, develop patriotic values, and discover the practical importance of their knowledge. The use of interactive mobile platforms and digital applications, such as "Mriya" and "Can't Wait to Learn: Ukraine", supports the process of forming these competencies, provides independent study of the material, development of critical thinking, and motivation for a deeper examination of national history, science, and technology. Thus, the interrelation of key terms creates an integral system in which patriotic education, civic consciousness, and value orientations form the basis for the development of national-patriotic competence and professional identity of students. The integration of these elements into the educational process provides a combination of theoretical knowledge, practical skills, and value attitudes, which allows students to effectively implement their competencies, take an active part in public life, and realise the value of their professional activities for the development of the state, creating a harmonious connection between the educational and social aspects of their formation. Table 1 summarises the main approaches to the formation of patriotic values and professional identity of students.

**Table 1.** Conceptual approaches to the formation of patriotic values and professional identity of students

Concept/approach	Key features	Practical implementation	Ways of application by students
Value approach	Orientation to the formation of internal motivation, civic consciousness, and patriotic beliefs through awareness of the values of statehood, culture, and professional responsibility	Inclusion of moral, ethical, and cultural-patriotic components in the content of disciplines; formation of a system of personal and professional values through reflection and discussion	Participation in round tables "engineering education and national identity"; discussion of the code of professional ethics, creation of value essays on the role of Ukrainian scientists in world science
Integrated approach	Combining professional knowledge with a patriotic component; ensuring interdisciplinary links between technical, humanitarian, and social disciplines	Integration of historical-cultural elements into educational modules of technical specialties; application of intersubject projects to increase civic responsibility	Development of technical projects dedicated to the restoration of infrastructure in Ukraine; creation of posters "Ukrainian scientists and innovations" within the course "History of science and technology"
Activity-based approach	Formation of patriotic values through active participation in practical activities aimed at socially useful results; emphasis on experience, self-realisation, and collective work	Attracting students to scientific-practical, volunteer, cultural-educational projects; stimulating social activity and initiative	Organisation of charity initiatives "Education for victory"; participation in volunteer programmes for digital support of schools, conducting patriotic excursions in Kyiv
Digital-interactive component	Using mobile apps and educational platforms to integrate patriotic content into the digital learning space	Application of the applications "Mriya" and "Can't Wait to Learn: Ukraine" in the educational process to form civic responsibility and emotional connection with national culture	Performing interactive tasks in mobile applications, creating digital maps of historical events, participating in national online quizzes dedicated to Ukrainian engineers and inventors

**Source:** compiled by the author on the basis of the following sources: O. Prytula (2023), N. Spielmann *et al.* (2020), A. Maksiutov & V. Honcharuk (2023), V. Bogouta (2024), Ministry of Youth and Sports of Ukraine (2024)

Practical aspects of these concepts were implemented through the development of student initiatives, organisation of presentations, excursions, participation in volunteer programmes, and the use of digital platforms and mobile applications for interactive work, which contributed to the

development of professional identity and citizenship of future specialists. A separate place in the system of patriotic education as a factor of professional identity of future specialists was taken by innovative learning tools, particularly mobile applications and digital platforms, which

provided interactivity, accessibility, and practical orientation of the educational process. The use of these tools contributed to the formation of students' critical thinking, analytical skills, and digital communication skills, deepened their understanding of national and professional values through participation in virtual projects, online discussions, quests, and social initiatives. Such innovations integrated educational and upbringing aspects, contributing

to the combination of patriotic and professional guidelines into a coherent system of worldview and behavioural attitudes. Table 2 summarises the main characteristics of mobile applications and platforms aimed at the formation of professional identity and national-patriotic competence of students, reflecting their educational goals, interactive opportunities, performance criteria, and expected results of use in the educational process.

**Table 2.** Characteristics of mobile applications and platforms for the formation of professional identity and national-patriotic competence of students

App/platform	Year of creation	Target audience	Educational goals	Main content and structure	Interactive features	Performance criteria	Expected results
"Mriya"	2024	Students of higher educational institutions, high school students, young teachers	Formation of a sense of national dignity, pride in the achievements of Ukrainians, development of historical memory	Thematic routes, biographical references, cultural maps, interactive quests, module "Ukrainian innovators"	Virtual tours, AR/VR modules, activity points system	User engagement, level of independent activity, depth of material assimilation	Growth of patriotic motivation, activation of self-educational activities, development of communication and digital skills
"Can't Wait to Learn: Ukraine"	2022	Children and students studying in war or migration conditions	Ensuring continuity of education, developing civic consciousness, fostering tolerance and national solidarity	Multimedia lessons, interactive tasks on the Ukrainian language, culture, history, section "United Ukraine"	Educational games, individual profiles, digital certificates	Success in completing tasks, motivation for self-study, stability of attendance	Development of value orientations, civic responsibility, adaptation to crisis conditions
"Ukraine without borders"	2023	Students, teachers, participants of educational programmes from Ukraine and the diaspora	Deepening knowledge about Ukrainian culture, science, history, supporting academic mobility	Online courses in history, literature, geography, innovation, webinars with experts	Forum discussions, interactive tests, video conferences	Quality of interaction, dynamics of course completion, level of cross-cultural communication	Development of professional identity, cultural identity, and social activity

**Source:** compiled by the author based on the analysis of "Mriya" modernises school education in Ukraine – president during app launch (2024), New app to bring education into the hands of displaced Ukrainian children (n.d.), Ukraine unlimited learning (n.d.)

The presented mobile applications and educational platforms have taken a separate place in the process of forming national and patriotic values and professional identity of students, as they combine digital mobility, educational depth and educational potential. Their effectiveness lies in creating an environment where cognitive activity is combined with emotional and value experience, and national consciousness is formed through interactive communication. The use of gamified tools, progress analysis, virtual tours, and thematic modules contributes to a deeper understanding of the role of civic responsibility,

historical heritage, and professional self-realisation in the context of the state.

#### **Assessment of the level of patriotic education and professional identity of students**

The level assessment determines the degree of formation of students' patriotic values, civic consciousness, and professional identity, which reflects the effectiveness of the implemented pedagogical methods. It allows identifying the dynamics of the development of personal and professional qualities, and comparing the results of

experimental and control groups to determine the impact of innovative training technologies. Table 3 reflects the dynamics of growth of activity of students of the experimental group in comparison with the control group

for three months, which indicates the effectiveness of interactive modules, scientific-practical projects and cultural and educational activities in increasing involvement in the educational process.

**Table 3.** Forms of work and activity of students in the experimental and control groups

Month	Form of work/activity	Experimental group (%)	Control group (%)
Month 1	Interactive modules	60	40
Month 2	Scientific and practical projects	65	35
Month 3	Cultural-educational and volunteer events	70	30

**Source:** compiled by the author

The data presented in the table show that during the three months of experimental work, students in the experimental group showed a higher level of activity compared to the control group. In the first month, the highest percentage of activity was observed during the implementation of interactive training modules that combined theoretical knowledge with practical tasks on the history of Ukraine and the achievements of Ukrainian scientists, and amounted to 60% in the experimental group, while in the control group, it was only 40%. This indicated that the use of mobile applications and innovative programmes increased students' interest and encouraged them to actively participate in the educational process from the first weeks. In the second month, the activity of students in the experimental group increased to 65% during scientific-practical projects, which included the creation of presentations, analytical reports, and group studies, while in the control group it was only 35%, which was explained by the lack of an interactive component and the use of traditional forms of work.

During the third month, the experimental group achieved the highest level of activity of 70% during cultural-educational and volunteer activities, in particular, excursions, master classes, and participation in charity projects, while the control group remained at the level of 30%. The lowest activity rates were recorded in the control group during all three months, which emphasised the effectiveness of using innovative teaching methods and interactive platforms for the development of patriotic values and professional identity. Thus, the table showed a gradual increase in activity in the experimental group from 60% in the first month to 70% in the third, while the control group remained at consistently lower rates, reflecting the difference in students' motivation and involvement in the educational process. Table 4 also showed a gradual increase in the level of professional identity of students in the experimental group compared to the control group, which confirmed the positive impact of innovative teaching methods on the formation of professional self-awareness.

**Table 4.** Average results on the professional identity scale

Month	Experimental group (%)	Control group (%)
Month 1	61.7	60.5
Month 2	68.7	63.2
Month 3	77.3	65.8

**Source:** compiled by the author on the basis of H.R. Woo (2013)

Table 4 illustrates the dynamics of changes in students' professional identity during the experiment. The highest average indicators in the experimental group were observed in the third month and amounted to 77.3%, pointing to a significant increase in the level of professional self-awareness and awareness of their own role in professional activities. The lowest rate in this group was recorded in the first month at 61.7%, which reflected the initial stage of professional identity formation and adaptation of students to interactive teaching methods. The control group showed lower results during all three months: 60.5% in the first, 63.2% in the second, and 65.8% in the third, where a minimum of 60.5% reflected limited development of professional identity in traditional teaching methods, and a maximum of 65.8% indicated

a slight improvement without significant dynamics. The differences between the groups highlighted the effectiveness of innovative methods, integrated tasks, and mobile applications that encouraged students to actively participate in educational and scientific activities. The dynamics of changes showed a gradual increase in the average values of the experimental group by almost 15.6% over three months, while in the control group, the increase was only 5.3%, which confirmed a more effective formation of professional identity through the use of innovative approaches. Table 5 showed a stable increase in the level of civic consciousness in students of the experimental group compared to the control group, which confirmed the effectiveness of interactive and volunteer forms of work in the development of patriotic values.

**Table 5.** Average results on the civic awareness scale

Month	Experimental group (%)	Control group (%)
Month 1	59.3	58.8
Month 2	67.3	62.1
Month 3	75.7	64.5

Source: compiled by the author on the basis of J. Remr (2023)

Analysis of Table 5 revealed a gradual increase in the level of civic consciousness among students in the experimental group. The highest rate on the CCS scale was 75.7% in the third month, reflecting the active participation of students in cultural and educational events, volunteer projects, and interactive discussions aimed at developing national consciousness and patriotic values. The lowest rate in this group of 59.3% in the first month reflected the initial level of civic consciousness at the start of the experiment. The control group showed lower results for all three months: 58.8% in the first, 62.1% in the second, and 64.5% in the third. The highest rate of 64.5% in the third month was evidence of some

improvement, but it remained lower than in the experimental group, while the lowest rate of 58.8% was indicative of limited activity and low participation in traditional forms of training. The dynamics of changes confirmed that innovative methods contributed to a faster and more effective formation of civic consciousness, the growth of which in the experimental group was 16.4% in three months, while in the control group – only 5.7%. Table 6 shows a gradual increase in academic results and project activity of students in the experimental group compared to the control group, confirming the positive impact of innovative teaching methods on the level of motivation and engagement of students.

**Table 6.** Academic results and activity in group projects

Indicator	Month	Experimental group (%)	Control group (%)
Academic results	Month 1	78	76
Academic results	Month 2	82	79
Academic results	Month 3	88	82
Activity in projects	Month 1	45	42
Activity in projects	Month 2	63	50
Activity in projects	Month 3	81	58

Source: compiled by the author

Table 6 displays the impact of innovative methods on academic achievement and student activity in projects. In the experimental group, academic performance gradually increased from 78% in the first month to 88% in the third, which was the highest rate among all the parameters under study. In the control group, the lowest rate was 76% in the first month, and the highest – 82% in the third, corresponding to the limited effectiveness of conventional training methods. Project activity in the experimental group increased from 45% in the first month to 81% in the third, while the control group showed lower values from 42% to 58%. The highest activity rates were recorded in the third month in the experimental group, which reflected the effectiveness of integrating practical and volunteer tasks, teamwork, and the use of mobile

platforms in the formation of patriotic values and professional identity. The lowest activity rates were observed at the beginning of the experiment in both groups, which highlighted the importance of consistently implementing innovative methods to encourage students' academic and civic engagement.

#### **Author's model of educational work for the formation of professional identity and national-patriotic competence of educational applicants**

Table 7 presents a model of educational work aimed at the formation of professional identity and national-patriotic competence of educational applicants, combining innovative methods, project activities, and value-oriented approaches.

**Table 7.** Model of educational work for the formation of professional identity and national-patriotic competence of educational applicants

Model component	Terms/key concepts	Implementation stages	Target audience	Practical actions and tasks
Integration of training courses and modules	Patriotic education, national-patriotic competence, value orientation	Selection of thematic courses and modules; integration into the curriculum	Students of technical and humanitarian specialities	Add blocks on the history of Ukraine, biographies of outstanding Ukrainian scientists and inventors, cases on national achievements to academic disciplines; conduct interactive classes and online tests to consolidate knowledge

Table 7. Continued

Model component	Terms/key concepts	Implementation stages	Target audience	Practical actions and tasks
Scientific and practical projects and research tasks	Professional identity, civic position, activity-based approach	Planning and execution of projects and research tasks	Students participating in scientific-practical laboratories	Develop group projects that combine technical tasks with social or patriotic aspects (for example, modelling infrastructure for cultural sites, examination of Ukrainian technologies), make presentations and reports
Cultural-educational and volunteer events	Emotional and value component, social activity, volunteering	Organisation of excursions, master classes, and charity initiatives	University students, youth organisations	Conduct excursions to historical and cultural sites, organise master classes in traditional crafts, participate in charity and volunteer projects, create social campaigns and initiatives
Systematic performance evaluation	Success criteria, academic achievements, project activity	Analysis of learning outcomes, project participation, and questionnaires	Students, teachers, project managers	Track students' progress through assessments, participation in projects, analyse questionnaire responses and reflections; use the results to correct programmes and provide recommendations for further development

Source: compiled by the author

Practical use of the developed model of educational work provides for a systematic combination of educational and upbringing components to form professional identity and national-patriotic competence of students. In the first stage, the model provided for the integration of thematic courses and modules with a patriotic component into the curriculum, providing for the combination of professional knowledge with the formation of value orientations, patriotic consciousness, and civic position. Students worked through educational blocks on the history of Ukraine, achievements of Ukrainian scientists, technological innovations, and cultural heritage, completed interactive tasks and cases that stimulated critical thinking, independent work with the material, and development of analytical skills. The use of interactive platforms and mobile applications, such as "Mriya", "Can't Wait to Learn: Ukraine" and "Ukraine without borders", allowed students to track their own progress, get real-time feedback, and consolidate their knowledge through practical tasks, quests and quizzes, which increased motivation to learn. The second stage of the model provided for active participation of students in scientific-practical projects and research tasks that combined professional competencies with patriotic and civic values. Students implemented group projects that included the development of technical solutions for socially significant initiatives, modelling of cultural heritage objects, creating information materials about Ukrainian scientific achievements, or conducting research on historical and technological topics. Performing such tasks stimulated teamwork, the development of critical thinking, the ability to plan activities, justify decisions and present results, which were important components of the professional identity of future specialists.

During the third stage, the model provided for the organisation of cultural-educational and volunteer events that formed the emotional and value component of identity and stimulated students' social activity. These events included excursions to historical and cultural sites, master

classes in traditional crafts, charity initiatives, volunteer programmes in the field of education and culture, and participation in student social projects. Practical activities in these events enabled students to experience their own patriotic self-determination, realise the importance of civic responsibility, and develop communication, organisational, and teamwork skills. In addition, the systematic assessment of the effectiveness of the model was performed through a comprehensive analysis of students' academic achievements, activity in projects, volunteer initiatives, and survey results, which helped adjust educational and educational activities, provide practical recommendations, and plan further steps in the development of the model. Based on the data obtained, strengths and gaps in the formation of patriotic and professional competencies were identified, enabling the improvement of educational programmes and providing an individual approach to students. Applying the model in practice ensured the holistic development of students, combining professional competencies with patriotic values, activated their participation in public life, and contributed to the formation of a responsible civic position. Due to the integration of digital platforms, scientific-practical projects, cultural-educational events, and systematic assessment, students assimilated knowledge in a dynamic, interactive environment, developed their own identity, and independently formed motives for professional and civic self-improvement. Thus, the model proved to be practically applicable in higher education and ensured the systematic and comprehensive formation of patriotic consciousness in the context of the professional development of students.

## DISCUSSION

Patriotic education influences the formation of professional identity of future specialists, strengthening their value attitude to the chosen profession, and reinforcing the sense of social responsibility. Students who were actively involved in patriotic events demonstrated a higher level of professional self-awareness, resistance to stressful

situations and readiness to integrate into the professional environment. These results are consistent with the findings of K. Azhboldaeva *et al.* (2022), which pointed to the effectiveness of student-centred technologies in the professional training of biology teachers, considering the regional component, which increased the sense of belonging to the local community and national culture. Patriotic education contributed to the development of moral and ethical values that served as the foundation of professional identity. In turn, A. Ilkhom *et al.* (2021) determined that education in the spirit of patriotism formed basic moral attitudes and civic consciousness in young people, which directly influenced professional choices and behavioural patterns in the work environment. Similar trends were recorded by O. Ilvovan (2025), noting that patriotic education through the geographical component of learning stimulated a sense of responsibility for the social and cultural environment, which subsequently strengthened students' professional identity. Data analysis showed that participation in patriotic initiatives, such as volunteer projects, cultural-educational events, and national-oriented trainings, contributed to the harmonisation of personal and professional qualities. This is consistent with the results of M. Bekmurodov *et al.* (2020), which proved that the process of harmonising students' personal and professional qualities directly correlated with involvement in socially important projects. Similar conclusions were reached by A. Abylkassymova *et al.* (2021), who underscored the role of theoretical foundations in shaping the professional direction of students of pedagogical specialities, which strengthened their readiness for independent decision-making in professional life. The results obtained showed that patriotic education was interrelated with increasing motivation for professional development and personal growth. In particular, B. Karipbayev (2021) stated that globalisation and non-traditional influences shaped the identity of Kazakh youth, where patriotic values played a key role in choosing a professional path. It was established that students who actively developed patriotic qualities showed increased readiness for social adaptation and professional mobility, which was confirmed by the paper of Y. Gao (2021) on the impact of political and economic factors on the professional identities of transnational intellectuals.

The relationship between patriotic attitudes and the formation of professional ethics is established. For example, Y. Chaaban *et al.* (2024), in their narrative study, found that teachers showed greater professional self-awareness when maintaining patriotic and ethical values in the career development process. This coincides with the results obtained, where a sense of national identity and patriotic attitudes contributed to the strengthening of professional responsibility and purposefulness in students. The study showed that patriotic education had a multidimensional effect on the formation of professional identity, including cognitive, emotional, and motivational components. The results of the analysis are in line with the conclusions of A. Indelicato & J. Martin (2024), who pointed out that national identity

and socio-economic factors are interrelated with attitudes to social groups and professional orientations, influencing decision-making and behavioural strategies. In parallel, M. Rizaie *et al.* (2023) demonstrated that patriotic attitudes and organisational civic behaviour increased the effectiveness of health workers, highlighting the importance of patriotism for professional success and social responsibility. It is established that patriotic education increases students' professional self-awareness through the integration of values, knowledge, and practical skills. In turn, A. Toker Gökçe (2021) emphasised the role of values in the professional education of future teachers, which is consistent with the results obtained, where patriotic values served as the basis for the formation of professional competencies. Thereby, C. Amorim & E. Ribeiro-Silva (2025) established that students' perception of initial training influenced their professional self-determination, confirming the importance of early involvement in patriotic and professional practices in building a sustainable identity. Patriotic education encourages the development of students' communication, organisational and creative abilities, which increases their competitiveness in the labour market. This parallels with the findings of H. Hasanovna (2023), who demonstrated that the competence-based approach to the development of professional and pedagogical creativity of future physical education teachers strengthened their readiness for professional challenges. Similar trends were observed by C. Zhang *et al.* (2024), clarifying that the academic and career expectations of medical master's students are interrelated with the formation of professional identity and personal values. The obtained data indicate the importance of combining patriotic education with professional training to increase the internal motivation of students. This is supported by the conclusions drawn by S. Suhi *et al.* (2021), K. Lin (2025), who noted that factors of social affiliation and national identity directly influenced the choice of career path and professional orientation of university graduates.

Similar results were recorded in a study by B. Michalik *et al.* (2024), where the presence of patriotic and value-oriented attitudes influenced the professional priorities of young doctors. Patriotic education affects not only professional identity but also the development of adaptive skills in students, enabling them to successfully integrate into the professional environment and society in general. This is in line with the study by Y. Li *et al.* (2021), where patriotic branding and values were shown to influence individuals' attitudes and behaviour, emphasising the importance of patriotic attitudes in shaping socio-economic activity. In parallel, T. Zhuang & X. Kong (2023) noted that the synthesis of neoliberal and Confucian values with patriotism formed a holistic perception of students' professional and personal roles, which coincided with the results obtained. Certain differences were recorded in the influence of patriotic education on professional identity in different socio-cultural environments. For example, H. Egginton & Z. Thomas (2020) stressed that gender and

social changes in Britain affected the perception of professional identity, and patriotic attitudes may have had a less pronounced effect compared to other countries. Such observations helped to highlight the need to adapt patriotic programmes to a specific socio-cultural environment and professional profile of students. Results outlined by K. Dancs & M. Fülöp (2020) demonstrated that patriotic education and professional identity directly influenced the position of graduates in the labour market, contributing to the active search for new opportunities and increasing competitiveness. This confirms that the introduction of patriotic values in professional training not only forms internal motivation and ethical attitudes but also positively affects the professional adaptation of students in real working conditions. Thus, their conclusions are in agreement with the results obtained, where participation in patriotic initiatives contributed to the development of professional competencies, readiness for independent decision-making, and social mobility of future specialists. The generalisation of these results reveals that the combination of patriotic values with professional training contributed to the harmonious development of students' identity and increased their readiness for professional and social self-realisation in a dynamic labour market.

## CONCLUSIONS

Platforms and applications such as “Mriya”, “Can’t Wait to Learn: Ukraine”, and “Ukraine without borders” provided interactive learning, development of critical thinking, analytical skills, and digital competencies, in addition to stimulating independent activity and teamwork. The inclusion of national historical content and volunteer initiatives allowed students to combine professional knowledge with patriotic values, forming an awareness of social responsibility and the impact of their future professional activities on the development of the state. The experiment confirmed that the integration of digital platforms into the educational process effectively increased students' motivation, activity, and value-oriented self-awareness, creating a harmonious link between education, upbringing, and social practice. The activity of students in the experimental group increased from 60% to 70%, which reflects the positive impact of interactive modules, scientific-practical projects, and cultural-educational events. On the professional identity scale, the level increased from 61.7% to 77.3%, and civic consciousness – from 59.3% to 75.7%, which demonstrates a deeper awareness of professional role and social responsibility. Indicators of academic performance and project activity also had a noticeable positive trend – up to 88% and

81%, respectively. In the control group, there was a slight improvement, but it was less pronounced, suggesting a limited effectiveness of conventional training methods. Thus, the use of innovative technologies, mobile platforms, interactive forms of work, and project activities has proved its effectiveness in the formation of patriotic values, increasing civic activity, and strengthening the professional identity of future specialists.

Based on the results of the study, it was determined that the use of the author's model of educational work effectively contributed to the formation of professional identity and national-patriotic competence of students. The integration of thematic courses and modules with a patriotic component allowed combining professional knowledge with the formation of value orientations, civic position, and awareness of social responsibility. Students actively conducted scientific and practical projects and research tasks that combined technical competencies with patriotic and civic values, developed critical thinking, planning skills, teamwork, and presentation of results. Cultural-educational and volunteer activities stimulated the emotional and value component of identity, expanded social activity and practical application of knowledge. The use of digital platforms and mobile applications, such as “Mriya”, “Can’t Wait to Learn: Ukraine”, and “Ukraine without borders”, provided interactivity of training, tracking progress, and motivation for independent study of the material. Systematic assessment of the effectiveness of the model allowed for adjusting educational and upbringing activities, maximising the effectiveness of the professional and patriotic awareness formation, which confirmed the practical value of the developed model in the training of future specialists. A limitation of the study was that the experiment was conducted only on the basis of one higher education institution, which limits the overall generalisability of the results obtained. The prospect of further research is to evaluate the influence of gamification and virtual simulations on the development of patriotic values, civic consciousness, and professional identity of students in the context of integrating education and upbringing.

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## CONFLICT OF INTEREST

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### Патріотичне виховання як чинник професійної ідентичності майбутнього фахівця

**Анотація.** Метою дослідження було визначення ефективності застосування інноваційних педагогічних підходів і виховних заходів у розвитку професійної ідентичності та національно-патріотичних цінностей у студентів. Методологія дослідження включала комплексний підхід, який поєднував теоретичний аналіз, педагогічний експеримент і розробку авторської моделі виховної роботи. У ході експерименту було встановлено, що використання цифрових платформ та мобільних додатків, таких як «Мрія», «Can't Wait to Learn: Ukraine» та «Україна без меж», забезпечило інтерактивність навчання, розвиток критичного мислення, аналітичних умінь і цифрових компетентностей студентів, а також стимулювало самостійну роботу та командну взаємодію. Результати дослідження показали, що рівень сформованості патріотичного виховання як чинника професійної ідентичності студентів експериментальної групи зріс значно активніше, ніж у контрольній групі. Протягом трьох місяців активність студентів експериментальної групи підвищилася з 60 % до 70 %, рівень професійної ідентичності зріс із 61,7 % до 77,3 %, а громадянська свідомість – із 59,3 % до 75,7 %. Академічні результати та активність у проектах показали позитивну динаміку – відповідно 88 % та 81 %. У контрольній групі покращення було незначним і менш вираженим, що свідчить про обмежену ефективність традиційних методів навчання. Отже, інтеграція інноваційних технологій, мобільних платформ, інтерактивних форм роботи та проектної діяльності підтвердила свою результативність у формуванні патріотичних цінностей, підвищенні громадянської активності та зміцненні професійної ідентичності майбутніх фахівців. Практичне значення дослідження полягає в тому, що його результати можуть бути використані викладачами, методистами, керівниками освітніх програм та адміністрацією закладів вищої освіти для впровадження ефективних стратегій патріотичного виховання та формування професійної ідентичності студентів

**Ключові слова:** громадянська відповідальність; моральні цінності; професійна свідомість; національна ідентичність; особистісний розвиток

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## Knowledge test control of English for students of non-linguistic faculties

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**Abstract.** In this article, a study was conducted on the use of tests in English lessons. This research aimed to investigate modern ways in which tests were used to assess knowledge of English in non specialist faculties, and to identify productive methods for implementing the test tasks for students in higher education institutions. The methodology of this research was based on a theoretical analysis of scientific and methodological studies, systematisation of the findings of earlier sources, and the practical application of interactive methods of testing proposed by the British Council. It was established by the empirical methods that creative tasks help students to monitor and improve their skills. It was discovered by the observational methods that students completed tasks online using the material of the tests. As a result of the use of test tasks, the controlling, developmental, and corrective functions of tests were identified. By the method of pedagogical analysis, it was determined that accessibility, systematicity, simplicity, adequacy of assessment, and differentiation are the main principles of control. Following practice, accuracy, developed speaking skills, and language proficiency in English were identified as common estimation criteria for assessing students' foreign language competence. By the method of diagnostic activity, there were detected the aspects of knowledge control: the degree of mastery of English topics, the acquisition of lexical and grammatical minimums, the ability to apply knowledge, and the use of additional literature. and logical speaking. The practical value of the research lies in the students' ability to identify and correct errors quickly, check results, and independently improve their skills; in motivating future specialists to study English; and in providing useful insights for foreign language lecturers to test students' knowledge in non-specialist faculties

**Keywords:** aspects of knowledge assessment; types of tests; criteria for test evaluation; principles governing knowledge assessment; functions of tests

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## INTRODUCTION

An analysis of research in the field of test use in the English language has shown that tests are an important structural component of learning. Testing has become the main method for assessing students' knowledge. When conducting an assessment, it is necessary to take into account the specific characteristics of a foreign language as a discipline of general or professional orientation. As pointed out by O. Prykhodko & I. Yakushenko (2020), control was promoted to systematise knowledge of students. Different types of control helped the lecturers to identify the depth of topic comprehension and prevent potential language

mistakes of students. The peculiarities of test-based assessment include the intensification of the educational process and the determination of the level of students' knowledge. A review of educational research showed that, in the existing conditions of study, distance assessment of students' knowledge is the most widely used approach. As O. Ilyina (2022) argued, distance assessment of knowledge requires a high level of learner organisation. However, online testing often lacks reliability and objectivity because of students' academic dishonesty. Students may use ready-made materials to improve their formal grades. The researcher



believes that the lack of clear criteria for knowledge assessment in distance learning reduced the effectiveness of full control. O.A. Hrolenko & E.B. Bondarenko (2024) distinguish two approaches to assessing students' knowledge. The first approach includes the formal recording of students' participation in distance learning activities.

The second approach involved the assessment of a student's foreign language competence. The researchers concluded that the proposed approaches were non-objective in reflecting the development of knowledge, skills, and competences of future specialists. The scholars suggested assessing the knowledge of students with the help of adaptive testing. The role of this type of assessment was to modify standard test tasks. It was necessary to take into account test complexity and the competence level of future specialists. The educators indicated that adaptive testing required clearly defined criteria for assessing students' knowledge and time constraints on testing. O. Bilyakovska (2022) defined a test as a system of tasks that can be used at different stages of learning. The scholar regarded testing as a pedagogical technology. It was considered an effective method for assessing the quality of knowledge of future specialists. Tests were distinguished from other forms of assessment by detailed content planning. They are standardised, static, and characterised by special grading procedures and accuracy of measurement. The effectiveness of test control depended on the conditions of its organisation and compliance with methodological requirements. Scholars identified several advantages of distance testing of students' knowledge, including task standardisation, the use of computer technologies for rapid verification of large volumes of responses, the ability to diagnose the quality of knowledge, application of various forms of assessment, quick evaluation, and feedback through commentary on assessment results. Educators have also identified the disadvantages of test-based assessment, such as the possibility of guessing answers, the inability to account for individual characteristics of students, the limited scope for creative responses, difficulties in developing multiple test variants, and the lack of assessment of speaking skills.

O. Gulich (2022) proposed methods to mitigate the disadvantages of distance assessment, including the use of diverse teaching formats, the introduction of innovative methods, and the modernisation of approaches to foreign language learning. In conditions of distance learning, test-based assessment is primarily used to evaluate students' grammatical skills. L. Lazarenko (2021) emphasised that the testing process enables the identification of topics that are poorly understood or misunderstood by students. The scholar also highlighted the need for both written and oral assessment of students' grammatical competence. Depending on the objectives of the test, the lecturer conducted an assessment of knowledge individually or in groups. The pedagogical principles of conducting online testing were also substantiated. The scholar also provided sample test tasks for assessing students' knowledge. E.V. Stryha (2024) released the requirements for grammatical knowledge

and skills of students. It was also emphasised that testing should be conducted in accordance with didactic principles. The scholar offered examples of test tasks of different types and levels for assessing the grammatical knowledge of future specialists.

The analysis of the research has revealed several issues associated with the use of tests. The first issue is the ambiguity in interpreting the principles of assessing students' knowledge. The second concerns the variety of criteria used to evaluate students' skills through testing. A further contentious issue is the effectiveness of using test tasks. It paid little attention to the assessment of the lexical knowledge of students and to the evaluation of creative approaches to task completion. In connection with the identified problems, this research aimed to analyse the existing methods of controlling students' assessing with the help of tests, to identify effective ways of using tests in nonspecialist faculties, to determine the principles of knowledge assessment, to establish criteria for evaluating students' foreign language skills, and to identify key aspects of knowledge assessment with the help of the tests.

## MATERIALS AND METHODS

The following methods were used in the research: theoretical analysis, systematisation, empirical analysis, survey methods, observation, diagnostic procedures, and analysis of practical activities. This combination of methods provided a comprehensive justification for the research problem and confirmed the validity of the obtained results. The empirical part of the research was conducted on the basis of higher education institutions in Ukraine. The study involved students enrolled in compulsory English language courses in non-linguistic specialities. The research was carried out at two higher education institutions, which ensured the diversity of the sample and increased the reliability of the results. Participants were recruited through institutional communication channels. Students were informed about the study by their English language teachers during online classes, as well as through official group chats in Viber and Telegram. Participation in the research was voluntary. Prior to the study, students were provided with information about the research objectives, procedures, and use of results. Only those who gave informed consent were included in the sample. The empirical study was conducted over one academic semester, from September 2024 to January 2025, which allowed observation of the dynamics of students' learning outcomes and attitudes towards testing under distance learning conditions.

The survey was conducted among groups of students studying English as a general discipline. It included the following questions: Which forms of assessment were most appropriate in conditions of distance learning? Which types of tests were considered optimal for the assessment of knowledge? What knowledge and skills can be assessed through testing? Which tasks were most engaging during lessons? Which tasks were most engaging for homework and self-study? Responses were provided

in free form. Data were collected via Viber and Telegram as interactive platforms, and Zoom as a communication platform. The mode of interaction included both synchronous and asynchronous formats. Students' individual attitudes towards testing as a form of assessment were also taken into account. Pedagogical observation was carried out over one semester in the selected groups. Group A was designated as the experimental, consisting of 46 students from the following specialities: 051 – Economics, 121 – Software Engineering, 014.09 – Computer Science, 022 – Design, 225 – Medical and Psychological Rehabilitation, 017 – Physical Culture and Sport. Group B served as the control group, consisting of 42 students from the following specialities: 053 – Psychology, 061 – Journalism, 081 – Law. The total number of participants was 88. The experimental group was taught using the author's methodology, which incorporated systematically designed test-based activities integrated into the learning process. The control group was taught using traditional methods, relying on standard forms of assessment without extended use of testing.

At the final stage of the study, a follow-up test and a repeated survey of the students were conducted. These methods of assessment enabled comparison of learning outcomes between the two groups. The assessment tools included language tests, achievement tests, and creative tasks (dialogues and short narratives). Students were given clear instructions for completing the tasks. Written responses were expected to contain approximately 10-15 sentences, while dialogues were required to include 6-8 lines per participant. These standardised instructions ensured the comparability of results and served as a basis for evaluating student performance. Methods of data collection and analysis included the processing of survey data, pedagogical observation, thematic analysis, and comparative statistical analysis. The testing was conducted in conditions of distance learning, in an online format. During regular learning activities, no strict time limits were imposed, and students were allowed to use additional sources. However, during control tests, students completed tasks within a fixed time frame and were not allowed to use external resources, which ensured the objectivity of the knowledge assessment.

During the experiment, students' rights were respected. Participation was voluntary, and students' confidentiality was maintained upon request. During work with students, ethical standards were observed according to Article 42 of the Law of Ukraine No. 2145-VIII (2017), as well as internationally recognised ethical principles, including those of the World Medical Association (2013). These documents emphasise voluntary participation, informed consent, confidentiality, and the protection of participants from potential harm.

In the process of the experimental study, students' language skills were monitored. Assessment of lexical skills on the topic "House. Flat" was conducted using the test Bedrooms (n.d.). The controlling function of the test was

demonstrated through the following tasks: labelling pictures, arranging words in alphabetical order, writing words from dictation, selecting one correct answer from three options, identifying correct or incorrect statements, grouping words by topic, and choosing the correct plural noun's form. The aim of the exercises was to support students in mastering the topic. The criterion of accuracy helped to monitor students' level of knowledge.

Test example 1 (Bedrooms, n.d.): Vocabulary A1-A2: Bedrooms – Grouping.

Task: Put the words in the groups.

Words: sheet, pillow, duvet, wardrobe, chest of drawers, bedside table, blanket.

Groups: 1. Things that go on a bed. 2. Furniture.

Lexical skills assessment on the topic "Travelling" was carried out with the test Air travel (n.d.). The developing function of the test was aimed at improving speaking skills. The attention of students was focused on specialised vocabulary related to air travel. The criterion of productivity was applied in solving a situational task, where students needed to choose appropriate terms. The creativity criterion was reflected in identifying novel solutions to the proposed situation, requiring respondents to add original information to their answers.

On the topic "Travelling", reading skills were also assessed. The aim of the assessment was to improve these skills. The interpretation criterion was applied in evaluating students' reading comprehension. Students completed the test, A travel guide (n.d.). Respondents performed various tasks, such as selecting the correct answer from multiple options, arranging sentences in chronological order, matching geographical names with their definitions, combining sentence beginnings and endings, and completing sentences. Pre-reading activities were often challenging for students. On some platforms, these exercises were referred to as "Preparation". Students were advised to read the text and translate it into their native language. Subsequently, unfamiliar words were identified and recorded in notebooks with their translation. If the words were difficult to pronounce, students wrote phonetic transcriptions too. After completing preparatory activities, students proceeded to pre-reading exercises. Students' attention was paid to the final tasks in the tests, referred to as "Discussion". By discussing the plot of the text and expressing their opinion, students were trained to read texts carefully. Future specialists also developed speaking literacy. Students were allowed to use words and phrases from the text in their answers and to incorporate information from other sources. They were also encouraged to add original content to their responses, in which case they could receive a higher mark. Thus, the controlling function of the complete test also served the purpose of improving language skills and competences.

Test example 2 (A travel guide, n.d.). Reading B1: A travel guide – 2.

Task: Are the sentences true or false? Indicate your answers in Table 1 using a plus sign.

**Table 1.** Analysis of the results of respondents' psychological

Statements	True	False
1. One night is enough time to see Bangkok.		
2. Khao San Road is an authentic Thai area of the city.		
3. Phra Kanong is further away from the main tourist sites than Khao San Road is.		
4. The river boat taxis often get stuck in traffic too.		
5. Taking the Skytrain is a faster way to see the city than going by taxi.		
6. You need to choose where to eat carefully, as not everywhere is good.		

**Source:** compiled by the author based on A travel guide (n.d.)

Grammar skills assessment on the topic "Present Simple" was conducted using the test Present Simple (n.d.). The purpose of this assessment was to systematise and consolidate the learned material, correct errors, and develop students' self-monitoring skills. The accuracy criterion was used to monitor students' ability to apply grammatical rules. The criterion of automatisisation has shown the extent to which grammatical skills were internalised. The reflexivity criterion referred to students' ability to explain rules independently. For assessing grammatical skills, the lecturer selected topics included in the curriculum. Students commented on the peculiarities of the verbs' usage and could revise the rules presented on the same platform. Grammatical tests supported the consolidation of learned material.

Test example 3 (Present Simple, n.d.): Grammar A1-A2: Present Simple – 2.

Task: Complete the sentences with the Present Simple form of the verb in brackets.

1. What time \_\_\_ he \_\_\_ work? (START)
2. We \_\_\_ to the same place on holiday every year. (GO)
3. My sister \_\_\_ chocolate. (NOT LIKE)
4. \_\_\_ they \_\_\_ a lot of sport? (DO)
5. I \_\_\_ meals very often. (NOT COOK)
6. Why \_\_\_ cats \_\_\_ all the time? (SLEEP)

7. He \_\_\_ to different countries for work. (FLY)

8. \_\_\_ you \_\_\_ this question? (UNDERSTAND)

Assessment of grammatical skills on the topic "Modal verbs" was carried out with the test Modals: permission and obligation (n.d.). Students learned to recognise different modal verbs. The developmental function aimed to improve the use of modal verbs in speech. During assessment, the criteria of accuracy, meaning, and range were used. Students learned to use modal verbs in correct forms and to construct negative and interrogative sentences accurately (accuracy). Future specialists tried to differentiate various meanings of modal verbs (meaning) and expanded their ability to use basic forms and equivalents of modal verbs (range).

Writing skills assessment was carried out using the test, An online discussion forum (n.d.). The purpose of this assessment was to enhance communicative competence. The criterion of interaction was applied to evaluate students' ability to communicate in an online environment, while the criterion of range was used to assess lexical and grammatical proficiency. Students were provided with special materials for discussion, which supported effective communication in online chats and forums. The assessment of acquired knowledge was carried out in test form.

Test example 4. Listening B2: A design presentation – 2.

Task: Match the useful phrases with the tips (Table 2).

**Table 2.** Matching phrases with the appropriate tips

Phrases	Tips
1. I'd now like to tell you about...	a) Refer to the audience's knowledge
2. As you know...	b) Refer to what images you are showing
3. Do you have any questions?	c) Tell them the structure of your presentation
4. I'd like to talk you through the following (three) points.	d) Use signal words to help them follow you
5. Firstly, ... / Next, ...	e) Tell them when you're moving on
6. In summary,...	f) Show them when you're near the end
7. As you can see ..., / You'll notice that...	g) Tell them the main points one last time
8. Finally, I'm going to talk you about...	h) Open up the discussion

**Source:** compiled by the author based on A design presentation (n.d.)

These tasks were aimed at independent work, as future specialists demonstrate different modes of perception and levels of information processing. The criteria of accuracy, depth of interpretation, and summation were applied. Students demonstrated the ability to recall details and facts (accuracy), to distinguish between factual information and the author's perspective (depth of interpretation). It was checked the capacity to summarise audio or video content

concisely (summarisation). If students were characterised with a similar level of skills, the lecturer could provide targeted materials. Tasks were selected in accordance with the group's proficiency level and were typically used for the final assessment. All exercises presented on the platform must be completed in the specified order. While watching videos, students may enable subtitles. If a video does not include subtitles, students may watch the video while

simultaneously reading the accompanying text. Students are advised to focus on the questions for discussion.

The tests revealed lexical, grammatical, and syntactic errors in online communication. Mistakes were often made due to students' haste and inattention. For the purpose of correction, methods of self-assessment and peer assessment of written work were used. Students' errors could be corrected independently through careful analysis of their work. Respondents' assessment of speaking (Talking about personal interests, n.d.) and listening (A design presentation, n.d.) skills was carried out according to students' choice, taking into account their level of foreign language proficiency.

In practice, students completed various types of tests. As demonstrated by the examples, the tasks were designed to improve lexical and grammatical skills, with particular emphasis on developing reading and listening skills. The classification of tests into controlling, developmental, and corrective functions was based on a complex approach to testing as a tool for learning and assessment. The theoretical rationale for this classification lies in stimulating students' learning activity, providing feedback, and facilitating error correction during distance learning.

## RESULTS AND DISCUSSION

The survey data indicated that students considered testing to be the most appropriate form of assessment in conditions of distance learning. Most respondents believed that recognition tests were optimal. Tests of this type are based on selecting one correct answer from three or four alternatives. Students tended to perceive tasks requiring open-ended responses as complete and comprehensive, but approached them with reluctance due to fear of making mistakes. Future specialists believed that tests can be used to assess knowledge within a particular subject area. In class, students preferred exercises aimed at improving grammatical skills. The guiding framework was the proposed

model. The learning mechanism involved repeating sentence structures and the automatic application of grammatical rules. The exercises performed a corrective function. Respondents also liked searching for additional literature to complete their answers. The resources used were the internet-based materials. The learning mechanism included the development of analytical skills in working with sources. These exercises fulfilled a developmental function. Creative tasks were also of interest to students. They particularly engaged in writing short stories. Respondents were provided with lexical and grammatical models as support. The writing process involved selfassessment of grammar and subsequent sharing of texts. The mechanism of feedback within the group demonstrated the communicative effectiveness of the stories, indicating that the developmental function of this activity was effective.

Creative tasks, such as preparing dialogues of the students' choice for homework and independent study, were also of interest. The choice was a preference for one general topic for everyday communication, along with three to four more specific subtopics. Students had dialogue examples, thematic vocabulary, and key phrases as support. The learning process included defining communicative roles and objectives, exchanging opinions, and presenting dialogues in pairs. These exercises also served a developmental function. The survey data allowed the lecturer to implement interactive tests in the experimental group. These tests were intended for knowledge monitoring and self-assessment. The materials used included tests proposed by the British Council for learning English. The test execution process involved selecting the correct answer, entering responses, recording results, and calculating total scores. Interactive tests performed a controlling function. A comparison of students' learning outcomes is presented in Table 3, including both percentages and the number of respondents in the experimental and control groups.

**Table 3.** Comparative overview of students' level of knowledge before the experiment

Level	Experimental group A, % (46 students)	Control group B, % (42 students)
excellent	19.56% (9)	9.52% (4)
good	34.78% (16)	38.10% (16)
satisfactory	36.96% (17)	42.86% (18)
unsatisfactory	8.7% (4)	9.52% (4)

**Source:** compiled by the author

The comprehensive tests revealed errors in the students' written responses in the control group. Three types of errors were identified: orthographic, grammatical, and lexical. The orthographic errors included omissions of letters and substitutions influenced by native-language phonetics. Examples of omissions (highlighted letters) include: 1) silent "e" – lake, fine, stare, tire; and diphthongs – clean, head, break. Examples of substitution include: 1) character – in answers were written "k" or "h"; 2) use of terminology: stomach, ache, psychiatrist – in answers were "c" or "k", physician – "f". During corrective practice, students were referred to a dictionary with phonetic transcription.

They also completed training tests focusing on the differences between pronunciation and spelling of similar words. In the written responses of the experimental group, no orthographic errors were identified.

Students in the control group also demonstrated weaker grammatical knowledge. Students of the experimental group made grammatical errors less frequently. The main types of grammatical errors included: 1) incorrect use of plural form (table – tables), 2) incorrect spelling of nouns – irregular plurals (man – men), 3) incorrect use of the third person singular (I look – he looks), 4) inappropriate use of articles before proper nouns (the

Times), and in the formation of superlative forms of adjectives and adverbs (the biggest, the best). In the process of correction, students constructed sentences using words that contained errors. The group collectively reviewed rules of forming plurals of nouns, usage of the third person singular, and the formation of comparative and superlative forms of adjectives and adverbs. After that, students completed online grammar tests with the function of self-assessment. All errors were analysed during lessons. Statistical analysis of mistakes in written answers had shown that 12 students in the control group made similar orthographic and grammatical errors, accounting for approximately 30% of participants.

Lexical errors were identified in both groups. The first type involved incorrect use of synonyms (to propose – to offer – to suggest). The second type concerned incorrect use of polysemous words (round: round the door, round face; second: three seconds, second class). The third type involved conversion (good – goods; a book – to book; blue – to blue). The fourth type included confusion between related words (new – newly – news – newspaper). With the aim of correction, students used vocabulary in different contexts. To strengthen vocabulary skills, students produced short oral narratives and dialogues in pairs based on the proposed topics, using the vocabulary provided in the test. In addition, respondents completed interactive tests with the ability to self-assess. Comparative and statistical analysis of responses in both groups showed that different formats of tests were more engaging for students in the experimental group. Respondents showed a preference for comprehensive tests. Twenty-one students (approximately 45%) demonstrated the ability to analyse errors and explain complex English rules to their peers.

In their responses, students often attempted to use machine translation tools. In conditions of distance learning, it was difficult to determine whether responses were

original or copied. Therefore, students were required to indicate the sources they had used when searching for additional information. Alternatively, responses could be based on materials provided by the lecturer, in which case students produced answers more independently.

Assessment of speaking and listening skills was conducted in the form of a narrative task. Students were required to use vocabulary from the video or audio materials in their responses. Both activities involved active viewing and listening, with writing remarks, attention to complex details, and completion of targeted exercises to ensure full understanding. For English language learning, the British Council recommends audio and video plots as supporting resources. The learning mechanism involves focused attention and integration of information. Video and audio materials served as a developmental function. Future specialists used grammatical structures drawn from the studied materials as additional support. Students also prepare dialogues in pairs if they wish, provided that the phrases correspond to the topic of the lesson. They were counted and assessed only when these conditions were met. Oral and written responses were assessed by the following criteria: accuracy of sentences, responses' completeness, relevance, and logical coherence.

The test's developmental function was to improve reading and speaking skills, as well as the ability to analyse and understand authentic texts. The test helped to identify common errors when working with texts. Not all students checked the dictionary when encountering new vocabulary, which led to spelling errors in their usage. The corrective function errors in their usage of new words, practising pronunciation of unfamiliar vocabulary. It also helped to get rid of grammatical errors in constructing negative and interrogative sentences. A comparison of students' achievements after the experiment is presented in Table 4. It was shown both as percentages and absolute numbers.

**Table 4.** Comparative overview of students' level of knowledge after the experiment

Level	Experimental group A, % (46 students)	Control group B, % (42 students)
excellent	30.43% (14)	9.52% (4)
good	43.48% (20)	52.38% (22)
satisfactory	26.09% (12)	38.10% (16)
unsatisfactory	0% (0)	0% (0)

**Source:** compiled by the author

In the process of the practical use of test-based assessment, it was found that tests remain a widely used form of knowledge assessment. It is considered that the test-based assessment is an effective method for improving students' knowledge. In the opinion of Y. Kolesnichenko (2026), tests helped to develop the cognitive interest of students. Y. Fabrychna (2021) also confirmed the effectiveness of tests in teaching; however, the scholar identified a significant limitation, namely that assessment is predominantly conducted in written form. Among the advantages of testing, the researcher highlighted diversity, the possibility for self-assessment, and peer assessment. Different types

of tests used by T.V. Savarin & M.Ya. Kichula (2023) at all stages of the educational process. According to these authors, the main advantages of testing include efficiency, availability of feedback, and stimulation of learning activity. The alternation of oral and written assessments enhances the learning process. Students were assessed individually, in pairs, or in groups, depending on the language skills being evaluated. S. Tsymbal & N. Yaremenko (2021) confirmed that the effectiveness of assessment increases through the forms' alternation. Pedagogues noted that oral assessment gave the opportunity to estimate the correctness and completeness of the answer, as well as the

identification of pronunciation errors. Students were allowed to correct mistakes independently. An important advantage of oral assessment is the provision of immediate feedback between student and teacher.

Lexical skills assessment helped to identify topics that were more engaging for communication. The results of the assessment showed which words caused spelling mistakes and what challenges students had when learning new vocabulary. According to I.Yu. Kulikova (2021), video materials allow students to observe authentic everyday situations. For the purpose of better memorisation, the lecturer proposed to students thematic vocabulary and lists of key phrases for communication. O. Ryzhchenko (2023) focused on the integrated usage of tasks for understanding and practising professional terminology. The scholar considered tests as training exercises with different functions and provided examples of test task implementation. In the process of assessment, the lecturer checked grammatical skills, lexical skills, and abilities of professional reading. Reading skills were analysed less extensively than other skills, although the use of authentic texts was considered essential for assessment. V. Denysenko (2023) also argued that authentic texts should be applied in comprehensive testing. Such texts are useful for activating and assessing grammatical and lexical skills. From the pedagogue's view, it was a productive way to combine oral and written assessment in the process of developing reading skills. A. Kotkovets (2021) recommended the use of non-communicative and conditionally communicative tests for assessing reading and listening skills. According to the author's study, applying different types of tests increased the objectivity of assessing students' skills. In the process of the practical application of test tasks, three main functions of tests were identified: controlling, developmental, and corrective. T. Valiiova (2022) concentrated on core subject-specific terminology and characterised educational and diagnostic functions. S. Nykyporets *et al.* (2022) indicated the main functions of tests as developmental, educational, controlling, and diagnostic. The principles of students' knowledge assessment were also defined. The main principles were accessibility, systematicity, simplicity, adequacy of assessment, and differentiation. Scholars argue that these criteria are most effectively applied across different types of assessment. In this study, general assessment criteria are also established. Important criteria of estimation were such as lexical and grammatical accuracy, the development of oral and written communication skills, and the appropriate use of language resources in English communication. Y. Fabrychna (2024) confirmed the importance of these criteria and provided examples of test tasks and creative assignments aligned with them. The scholar used tests as training tools, which contributed to the development of students' ability to translate professional texts, while also facilitating the assessment of vocabulary skills. Based on these criteria, Y. Kolesnichenko (2026) applied different types of tests and emphasised the need to select tests according to the level of students'

foreign language competence. The scholar also proposed assessing the development of communicative competencies. The scientist considered that language skills and abilities were a necessary component of the allocated competencies. Test-based assessment of knowledge includes five key aspects. The first is the degree of adoption of the topics of the discipline "Foreign language". The second is the degree of acquisition of lexical and grammatical minimums. The third aspect concerns the ability to apply knowledge when completing various types of test tasks. The fourth reflects the usage of additional sources when performing creative tasks. The fifth involves logical and coherent speaking when presenting the creative tasks. Y. Kholmakova *et al.* (2021) described in detail the methodology of lessons with students according to these aspects. The authors considered the productivity of aspects in conditions of distance learning. According to the authors, online resources are flexible and interactive, enabling timely monitoring of students' understanding of learning materials. L. Lysenko (2025) confirmed that the main distinctive peculiarity of online tests is interactivity, the ability to check answers rapidly, and correct errors efficiently. N.V. Kuzmenko (2026) added that their standardised nature, online tests have interactive peculiarities and can be used to develop students' communicative skills.

As a result of the discussion, it was observed that tests are a widely used and effective method for assessing students' knowledge. It was determined that, under distance learning conditions, the most effective use of tests involves the application of different types of exercises, their integrated use, and the adaptation of tasks to different student proficiency levels. Tests helped future specialists improve their knowledge, supported learning, and facilitated the correction of language errors. Through test tasks, students were able to select more engaging topics for study. Future specialists showed interest in searching for additional information while preparing homework and independent assignments. Competence in professional terminology was also enhanced. It was considered that watching videos with further testing is an interactive method not only for assessing comprehension of students but also for developing cognitive competence and communicative skills. Online tests were used for both the development and assessment of various language skills. The effectiveness of developing these skills depends on the principles of knowledge assessment. Tasks had developmental, controlling, and corrective functions. The objective assessment of students' knowledge depends on clearly defined criteria and assessment aspects. The advantages of tests were quick feedback and interactivity, while the disadvantages include limitations in assessing reading and listening skills, a lack of oral assessment, and the difficulty of verifying the authenticity of students' responses. These limitations can be addressed by combining written and oral assessments, varying types of student activity in the lessons and during independent study, and providing opportunities for self-assessment and peer assessment.

## CONCLUSIONS

It was confirmed in the research that test-based assessment is an effective method for monitoring students' knowledge of English. In practical application, lexical and grammatical skills were assessed, as well as listening, reading, speaking, and writing skills. Thus, the use of complex interactive tests in English language learning indicated a significant improvement in students' knowledge. Depending on the function of the test – controlling, developmental, or corrective – gaps in students' knowledge were identified. Students developed skills in self-assessment and peer assessment. Knowledge assessment was based on such principles as systematicity, simplicity, accessibility, adequacy of assessment, and differentiation. The assessment of knowledge, skills, and competences of students in the control group showed that respondents tended to complete standard tasks. Many students were unable to analyse their own errors. Approximately 30% (12 students) of students in the control group made the same orthographic and grammatical errors. These respondents preferred written reproductive exercises and tasks based on fixed models. Students in the control group used a limited vocabulary when attempting creative tasks. Future specialists were not consistently motivated to complete tasks successfully. Students in the experimental group demonstrated greater interest

in completing diverse types of tests, particularly comprehensive tests. About 45% (21 students) in the experimental group were able to analyse errors and explain complex rules to their peers. Respondents successfully completed both oral and written tasks. When performing creative tasks, students actively used online resources. The results of their work were presented in the form of stories and dialogues. Motivation to learn English was high. An analysis of Ukrainian studies showed that tests are widely used for assessing lexical and grammatical skills. Researchers also use video materials and various types of exercises to develop the students' professional foreign language competence. However, relatively little attention has been paid to the assessment of speaking and listening skills. In this regard, further research should focus on the peculiarities of assessing these skills.

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<https://orcid.org/0000-0003-3957-0257>**Тестовий контроль знань із англійської мови студентів немовних факультетів**

**Анотація.** У статті розглянуто засоби використання тестів на заняттях із англійської мови. Метою роботи було дослідити сучасні форми тестового контролю знань майбутніх спеціалістів у закладах вищої освіти, виявити дієві засоби впровадження тестів у навчальний процес на нелінгвістичних факультетах вищих навчальних закладів. Методологія даного дослідження базувалася на теоретичному аналізі наукових і методичних досліджень, систематизації результатів попередніх розвідок та на практичному використанні інтерактивних методів тестування, рекомендованих Британською Радою для вдосконалення знань із англійської мови. Емпіричним методом встановлено, що творчі завдання допомагали контролювати та покращувати навички студентів у їхньому іншомовному говорінні. Методом спостереження виявлено, що студенти виконували пропонувані завдання та вивчали правила спілкування онлайн за матеріалами тестів. В результаті використання тестових завдань відзначено загальні функції тестів: контролюючу, розвивальну та коригувальну. Методом педагогічного аналізу визначено доступність, системність, посиленість, адекватність оцінювання, диференційованість як головні принципи у контролі знань студентів. В результаті практичної діяльності автора дослідження виокремлено основні критерії оцінювання іншомовних навичок студентів: лексична і граматична грамотність, сформованість навичок усного та писемного мовлення, використання мовних засобів у спілкуванні англійською мовою. Методом діагностичної діяльності виявлено наступні аспекти контролю знань за допомогою тестів: ступінь засвоєння студентами розмовних тем дисципліни «Іноземна мова», ступінь володіння лексико-граматичним мінімумом, вміння застосовувати засвоєні знання при опрацюванні тестових завдань різних типів, вміння користуватися додатковою літературою для виконання творчих завдань, логічність висловлювання при презентації творчого завдання. Практична цінність дослідження полягала у можливості студентів бачити власні проблеми у вивченні англійської мови, самостійно перевіряти результати, швидко коректувати помилки, а також у мотивації майбутніх спеціалістів покращити власні мовні навички; результати дослідження можуть бути корисними викладачам іноземної мови для перевірки знань студентів на немовних факультетах

**Ключові слова:** аспекти контролю знань; види тестів; критерії оцінювання тестів; принципи, що регулюють оцінювання знань; функції тестів

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## Exploring the role of gamification in enhancing engagement of maritime professionals to study

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**Abstract.** Digitalisation and higher training demands make it increasingly important to enhance maritime students' engagement. Gamification is considered an innovative approach that contributes to the intensification of educational activities and increases the effectiveness of professional training of maritime specialists. The objective of research was to explore the role of gamification in enhancing engagement in seafarers' training online courses. The research methodology was based on a combined set of interconnected theoretical (analysis, synthesis, generalisation, comparison) and empirical methods (pedagogical experiment, observation, survey, testing), which provided a comprehensive study of the process of training future ship mechanics in a digital learning environment. The study analysed the possibilities of using gamification in e-learning for future maritime specialists on the LMS Moodle platform. It was found that the introduction of gamification elements, in particular maps, scores, leaderboards, digital badges, game exercises, task performance indicators, levels and missions, helps to increase the interest and involvement of cadets in the educational process. A gamified online course on the discipline "Life Safety" was developed, which contains educational materials on personal safety, firefighting, survival and first aid. The practical experience of creating gamification elements both in the LMS Moodle environment and on external web resources, with their subsequent integration into the educational course, was described. It was found that the use of gamification forms a more dynamic educational environment and has a positive effect on the motivation and educational activity of students. The study proved that gamified online courses increase learning efficiency and improve the overall educational experience of future maritime professionals. The results of the study can be used by teachers of maritime educational institutions to implement gamified approaches to increase the motivation and involvement of future maritime professionals in the learning process

**Keywords:** maritime establishments; personalised space; digital surroundings; e-learning; ship engineers

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## INTRODUCTION

Ukrainian Maritime Education and Training (MET) is going through hard times due to the state of martial law in the country. The use of e-learning became more needed than ever. Almost every higher education institution has its own Learning Management System (LMS) which is an essential instrument to organise e-learning. One of the most widely used LMS is MOODLE. It is freely available for use and can be customised to suit specific needs without licensing costs. This makes it a cost-effective solution for organisations with budget constraints (Dewan & Godina, 2024). The MOODLE is also chosen because it's very flexible and provides a framework which can be adapted to different learning styles, content types, and organisational structures. The platform's design is geared towards simplicity and supports various content types (e.g. text, multimedia, quizzes, forums, and assignments) (Yurzhenko *et al.*, 2022).

Despite MOODLE's advantages e-learning can become boring to students due to the limited set of tools and instruments on LMS. The challenges in motivation and engagement influence cadets' overall e-learning experience. To enhance it and find the solution it was decided to use gamification approach. Gamification approach is an innovative trend of education in 2026. It uses mechanics of computer games and can be used while e-learning. To adapt it to maritime education and training LMS MOODLE was used as a source of all materials to study. Gamification is considered to be an easy tool to use and engage cadets to study more. There are some gamification tools which involve cadets to challenge with each other (e.g. Leaderboards) (Kotsifakos *et al.*, 2022).

The researchers A.H. León & M. Peña (2021) used gamification tools in the learning of shipbuilding in the undergraduate marine engineering education in the Universitat Politècnica de Catalunya, BarcelonaTech. Kahoot!, Mentimeter, and Socrative gamification web tools were used in the research. The best results were shown by Socrative web tool. The authors were using external tools only and didn't provide any information on the use of gamification elements LMS MOODLE proposes. K. Kraft (2025) and K. Mizrak (2025) investigated the effectiveness of safety training through gamification, focusing on the analysis of game attributes and the design of training prototypes. As part of their work, a series of applications was developed to improve safety training. The results of pilot testing showed a high level of user engagement and satisfaction with the training process.

The following researchers had analysed the use of gamification in maritime education and training: T.T. Türkistanlı (2023) analysed the use of gamification in maritime education and proved that a digital gamification model increased the effectiveness of transforming cadets' digital readiness into a powerful factor of learning motivation. The researcher emphasised that the integration of game mechanisms (scores, levels, competitions) into the educational process did not deprive interest, but also contributed to the formation of self-regulation and active

participation of students. In addition, the author emphasised that gamification acted as a tool for the transition from passive knowledge acquisition to an interactive, effective learning model, which is especially relevant for the training of maritime specialists in a digital environment. T. Cheng *et al.* (2026) investigated the application of gamification in the field of maritime cybersecurity. In particular, they identified significant gaps in the training of logistics specialists in terms of awareness and response to cyber threats. Their study, conducted at the University of Plymouth, tested virtual game-based training that simulated real-world cyber incident scenarios in the maritime industry. The results showed that the use of game-based virtual environments significantly increased participants' success rates, facilitated better development of practical skills, and built sustainable cybersecurity competencies necessary for digital maritime industry.

C. Christodoulou Raftis *et al.* (2025) focused on the use of serious games in maritime education and training. They demonstrated that such games have significant potential to bridge the gap between theoretical knowledge and practical skills. The results of the study highlight the innovative nature of this approach and its effectiveness in the professional training of future maritime professionals. A large number of researchers have studied the use of gamification elements in education but the use of them while Basic Safety training online for future seafarers remains an unsolved issue. The main goal of the research was to explore gamification's role in the raise of cadets' engagement while MET, particularly Basic Safety.

## MATERIALS AND METHODS

The study employed a combination of interconnected theoretical and empirical methods, which is due to the interdisciplinary nature of the issues, which combines pedagogy, digital technologies and professional training of maritime specialists. The use of theoretical methods, in particular analysis, synthesis, generalisation and comparison of scientific sources, made it possible to determine modern approaches to the organisation of e-learning, the features of the use of gamification in the educational process and its potential for increasing the motivation of students. For this purpose, scientific publications, methodological recommendations, as well as electronic resources dedicated to the use of LMS MOODLE, gamification and digital educational technologies were processed. The empirical part of the study involved conducting a pedagogical experiment that was organised based on the Kherson State Maritime Academy (KSMA), Kherson, Ukraine, which was relocated to Odesa on the base of Odesa Agrarian University under martial law. The choice of this research base was due to its specialisation in the field of training maritime specialists, as well as the active use of e-learning in the educational process. The study was conducted in the first semester of the 2025-2026 academic year.

The study involved first-year cadets of Marine Engineering Faculty, who studied under the abridged program in the speciality "Operation of Marine Power Plants". The total sample consisted of 120 cadets. The distribution of cadets into the experimental group (EG) (58 people) and control group (CG) was considered randomly (random sampling) based on an assessment of the initial level of English proficiency and compliance with the specified selection criteria. The selection of participants was carried out according to the following criteria: first-year study, availability of the results of the entrance exam in English, voluntary consent to participate in the study, and an appropriate level of English proficiency. The participants were ship engineering cadets 17-21 years old.

To determine the initial level of preparation of the participants, the results of the entrance English test were used, which included testing in the LMS Moodle and an

oral interview on the Zoom platform. The testing allowed for assessing the level of development of audio, reading, writing and grammar skills, while the interview was aimed at determining the level of oral speech. The level of preparation was determined according to the Common European Framework of Reference for Languages (CEFR) scale at level B1. To clarify the initial level of development of foreign language competence of the cadets, a preliminary test was conducted in the LMS Moodle, which covered the main language competencies (listening, reading, grammar) according to level B1 of the CEFR. Oral competence was additionally assessed during a short interview. The test structure included the following types of tasks: listening to dialogues with a choice of different correct answers, determining the correctness of statements (True/False), reading texts with answers to questions, choosing the correct grammatical form, and filling in the gaps (Fig. 1).

1. Fill in the text with the given variants. There are two variants you don't need to use.

Question 1  
No answers yet  
Maximum score: 7.00 points

**Fill in the text with the given variants. There are two variants you don't need to use.**

The term "centrifugal pump" encompasses a multitude of pump technologies. Centrifugal means "directed or ", therefore a centrifugal pump uses a rotating impeller . Fluid enters the pump and is , or center, of the impeller and then is forced outward through the vanes (blades) via centrifugal force generated by the rotating action of the impeller. The fluid is forced to the  and out the pump's discharge. The flow of a centrifugal pump depends on the system pressure drop: , the lower the flow.

Lytron's cooling systems use seal-less, magnetically-driven centrifugal pumps, also known as mag-drives. Magnetically driven pumps use two magnets to drive the impeller. One magnet is attached to the . The other magnet is attached to the impeller (the "driven" or "impeller" magnet). The drive magnet spins causing the impeller magnet, and therefore impeller, to spin at the same rate. This pump design eliminates pump seals which often  of the motor shaft and are a source of leakage. In Lytron's centrifugal pumps, the drive magnet is integrally molded into the impeller and thermoplastically coated to ensure zero contamination of the pump fluid. Thus, "mag-drive" ensures pump integrity and eliminates any .

to move the fluid outward	moving from periphery to the center
drawn into the eye	the higher the system's pressure drop
motor shaft, generally referred to as the "drive magnet"	outside of the pump casing (or volute)
possibility of shaft or seal leakage	inside the pump casing (or volute)
moving away from a center or axis	wear out from the friction caused by the rotation

Figure 1. Example task

Source: Online learning at the Kherson State Maritime Academy (n.d.)

The data collection during the pedagogical experiment involved a combination of pre-testing and post-testing, questionnaires, interviews, and pedagogical observation. To determine the initial level of English-language competence, pre-testing was conducted in the LMS Moodle before the implementation of the experimental methodology. After the intervention, post-testing was carried out in the same environment to assess the dynamics of learning outcomes and measure the effectiveness of the applied approach. To evaluate the motivation and engagement of cadets, questionnaires were administered via Google Forms, enabling the identification of their attitudes towards the use of digital and gamified tools in

Maritime English learning. Interviews complemented the quantitative data by providing deeper insights into students' perceptions and experiences.

Pedagogical observation was used to record the characteristics of cadets' learning activities during the use of e-learning, in particular the level of activity, independence, and engagement. The collected data were processed using both descriptive and inferential statistical methods, which ensured a comprehensive analysis of the effectiveness of the implemented approach. Figure 2 shows some sample questionnaire questions to assess students' attitudes towards gamification and their level of learning motivation.

1. How often do you use digital platforms (Moodle, eLearningApps, etc.) for learning Maritime English?
  - Always
  - Often
  - Sometimes
  - Rarely
  - Never
2. Do game-based activities help you better understand professional vocabulary?
  - Yes
  - Rather yes
  - Not sure
  - Rather no
  - No
3. Which type of tasks do you find most engaging?
  - Vocabulary exercises
  - Grammar tasks
  - Interactive games
  - Speaking tasks
  - Case studies
4. Do you feel more motivated when using gamified elements (points, badges, leaderboards)?
  - Yes/No (explain why)
5. How confident do you feel using Maritime English in professional situations?
  - Very confident
  - Confident
  - Not very confident
  - Not confident
6. What difficulties do you face when learning Maritime English? (open-ended question)
7. In your opinion, do digital tools help you learn independently? (open-ended question)

**Figure 2.** Questionnaires

**Source:** Online learning at the Kherson State Maritime Academy (n.d.)

These questions made it possible to collect both quantitative data (on a scale, for example, from 1 to 5) and qualitative responses (open-ended comments), which provides a deeper analysis of the learning process. The choice of these methods was due to the need to obtain both quantitative and qualitative data for a comprehensive analysis of the phenomenon under study. The study materials consisted of training courses developed in the LMS Moodle, as well as gamification elements integrated into the e-learning structure. It should be noted that all screenshots presented in the article, as well as the general demonstration of the website interface, were obtained while using a personal account of one of the authors. Additionally, external electronic resources were used to create interactive tasks with further integration into the learning platform, including LearningApps.org (n.d.) for designing interactive exercises, Kahoot! and Quizizz for gamified quizzes, and H5P for developing multimedia learning content (interactive videos, presentations, and quizzes).

The study was conducted in accordance with established ethical standards for research involving human participants. In particular, the research adhered to the principles of voluntary participation, informed consent, confidentiality, and anonymity of respondents. All participants were informed about the purpose, procedures, and expected outcomes of the study and provided their voluntary consent to participate. The confidentiality of the collected data and its use exclusively for scientific purposes were ensured. The study was conducted in compliance with the ethical principles outlined in the guidelines of The

European code of conduct for research integrity (n.d.) and the General data protection regulation (2018). The research also respected the principles of academic integrity, including honesty, transparency, and respect for the dignity and rights of all participants.

## RESULTS AND DISCUSSION

KSMA was temporarily relocated to Odesa, Ukraine due to the occupation of region by Russian militaries and later due to severe bombing after de-occupation. The Academy lost its possibility to conduct offline learning and has chosen the only way to continue its activities – e-learning mode. LMS MOODLE was chosen as one platform where all online courses are settled. Basic Safety course is one of the essential courses for future maritime professionals as it provides the knowledge on personal safety, basic firefighting, personal survival techniques and elementary first aid. The marks (course points) were chosen as the main quantitative indicators of EG and CG. To motivate cadets more in achieving higher scores gamification approach was chosen as one of the main key elements. As one of the gamification elements the course has map at the beginning so that every user can check the lists of course topics (Shortt *et al.*, 2023). Map also serves as a visual or detailed overview of the structure, content, and objectives of the course.

All course participants receive points for the activities they complete during the learning process. These points serve as an indicator of students' progress and encourage active participation in course tasks. The full list of activities and the corresponding number of points for each

task are indicated in the Gradebook, which functions as a transparent system for monitoring learning achievements. Before the course begins, the tutor must properly set up the Gradebook by defining the types of activities, their weighting, and the maximum number of points that can be obtained for each task.

Cadets can access information about the grading system through the course map, which provides a clear overview of the course structure and assessment criteria. By reviewing the map, students can see the types of

activities included in the course, such as quizzes, assignments, discussions, or collaborative tasks, as well as the number of points they may receive after successfully completing them. This approach helps cadets better understand the expectations of the course, plan their learning activities, and monitor their own progress throughout the training process. Moreover, the use of a structured Gradebook (Fig. 3) promotes transparency, fairness in assessment, and motivates learners to complete all tasks in order to achieve higher results.

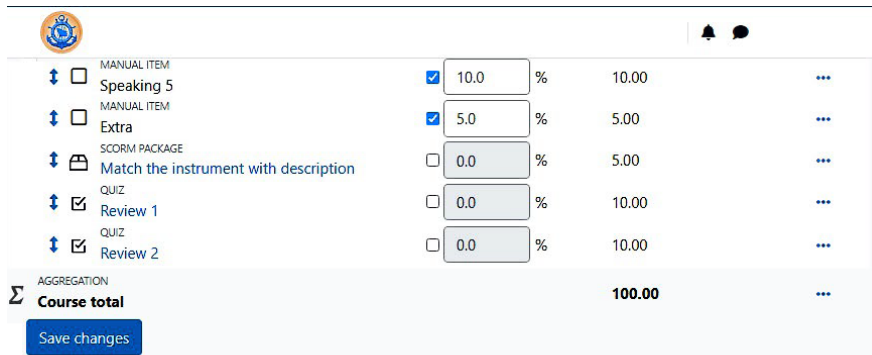


Figure 3. Gradebook on LMS MOODLE with points setup

Source: Online learning at the Kherson State Maritime Academy (n.d.)

To enhance engagement and foster healthy competition among learners, leader boards are also used as an effective gamification element in online learning environments. Leader boards display the results of participants and allow cadets to compare their achievements with those of their peers, which can increase motivation and stimulate active participation in course activities. In the MOODLE, tutors could create leader boards automatically based on the results of assessed activities. This feature allows instructors to visualise students' progress and highlight the most active or successful participants in the course (Gurbuz & Celik, 2022).

To create a leader board, the tutor first turns on the editing mode in the course. After that, the instructor adds the Activity results block, which is responsible for displaying students' performance data. Once the block is added, it must be configured according to the course requirements. During the configuration process, the teacher selects the specific activity or assessment item from which the results

will be displayed, such as a quiz, assignment, or other graded task. In addition, the teacher can determine how many students will appear on the leader board, for example by showing those with the highest or lowest marks. This flexibility allows tutors to adapt the leader board to the pedagogical goals of the course (Walker *et al.*, 2025).

MOODLE supports the use of badges as a gamification element to recognise and reward learners for their achievements. To add new badge tutor needs to choose in the Administration block – Badges – Add new badge. When cadets complete particular activities well they can automatically or manually receive the badges (Wahyuni & Iing, 2021). In order to collect all the possible badges on the course cadets try to do all the activities as best as they can. For example, the badge illustrated below is given by the end of First Aid module when cadets make their presentations on “First aid kit on the vessel” topic and teacher mark them (Fig. 4).

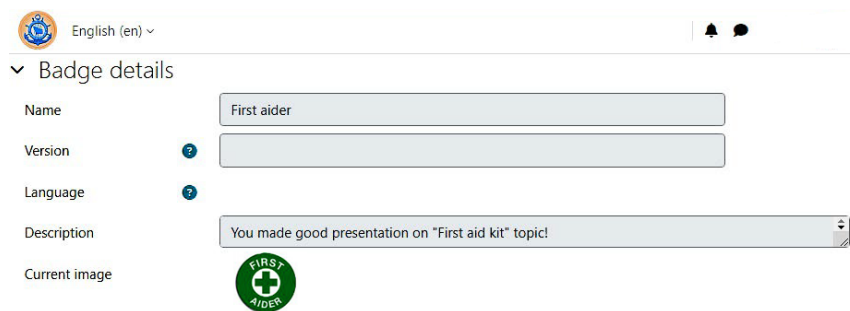
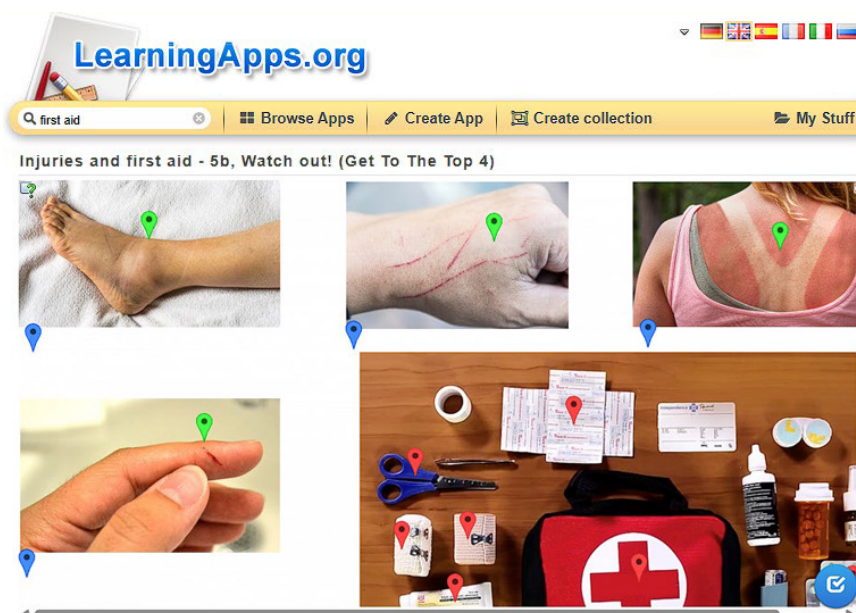


Figure 4. “First aider” badge details set up section opened by tutor

Source: Online learning at the Kherson State Maritime Academy (n.d.)

Game-based activities are mostly transferred from external websites (LearningApps.org, n.d.) which provide interactive tasks and exercises. In the MOODLE learning management system, such activities can be added using a special activity type called a SCORM package. This tool allows teachers to import ready-made interactive learning materials into the course and make them accessible to students. To add this activity, the teacher first turns on the editing mode in the course, selects Add an activity or resource, and then chooses the SCORM package option. After that, the instructor prepares the interactive activity

by exporting it as a ZIP file from the external platform and uploading it to the MOODLE course. Once uploaded, the activity becomes available for students to complete directly within the learning environment. Game-based activities can also include multimedia elements, such as videos, images, and animations, which make the learning process more engaging and interactive (LearningApps.org, n.d.) (Fig. 5). The use of such activities helps increase students' motivation, supports active participation in learning tasks, and contributes to better understanding of the educational material.



**Figure 5.** Game based activity from external website on the topic “First aid”

Source: LearningApps.org (n.d.)

MOODLE provides flexibility in tracking and displaying learner progress, including the use of progress bars or circles, which allow both teachers and students to monitor the completion of course activities. These progress tracking tools are connected with the activities and resources within the course and help learners clearly see which tasks have already been completed and which still need to be done. Such visualisation of learning progress increases students' motivation and encourages them to complete tasks on time (Markopoulos et al., 2020).

The LMS MOODLE also gives tutors the possibility to transform the course structure by integrating gamification elements, such as levels, missions, and sequential tasks. Teachers can rename course topics or modules according to the logic of the game and connect activities through specific settings. While editing the activity settings, the options Activity completion and Restrict access can be activated. In this way, a learner must successfully complete one task before gaining access to the next one. This approach creates a structured learning path that resembles game progression and stimulates cadets to continue their learning activities (Autsadee et al., 2023). The use of

gamification elements in the online course had a positive impact on students' engagement and learning outcomes. Questionnaire data showed that 78% of cadets reported increased interest in learning, while 71% demonstrated higher levels of intrinsic motivation.

By integrating elements such as points, leader boards, progress indicators, and sequential tasks, the learning process became more interactive and motivating for cadets. Cadets can clearly track their progress, compare their results with their peers, and see how each completed activity contributes to their overall performance in the course. This encourages them to participate more actively in learning activities and complete tasks more responsibly (Simanjuntak, 2024). Moreover, the use of various game-based platforms not only during classroom activities but also while completing home assignments further increased students' involvement in the learning process. Interactive tasks created on different digital platforms allowed cadets to practise professional vocabulary, grammar, and communication skills in a more engaging format outside the classroom. Such activities provided additional opportunities for independent learning and reinforced the material studied

during lessons. As a result, cadets remained actively involved in the course both during and after classes, which contributed to a deeper understanding of the content and more consistent development of their Maritime English skills (González Vallejo, 2024). According to Moodle analytics, overall learning activity increased by 37%, task completion rates by 42%, and independent work engagement by 29%.

In addition, gamified course design enables cadets to progress step by step through the course structure, completing tasks and unlocking new activities as they advance. This approach helps sustain learners' interest and supports their continuous involvement in the educational process. To evaluate the effectiveness of these pedagogical approaches, a comparative analysis of students' performance was conducted through pre-testing and post-testing stages. Students' motivation level (measured via questionnaires) and their improvement in test results are connected. Using correlation and regression analysis it can be said that motivation score and test results' improvements have strong positive correlation (with a correlation coefficient of  $r = 0.64$ , indicating a strong positive relationship between motivation and learning outcomes.). Cadets of EG became more independent and involved in educational process while experiment. In Figure 6, pre-testing has practically the same

results in both the control and experimental groups. This indicates that the initial level of students' knowledge and skills in both groups was approximately equal before the implementation of the experimental methodology. Such similarity in the results confirms the comparability of the groups and creates reliable conditions for conducting the pedagogical experiment. Therefore, any further changes observed during the post-testing stage can be attributed to the influence of the applied teaching methods and pedagogical conditions introduced in the experimental group.

The results within the experimental group were homogeneous. The comprehensive analysis of both performance and motivational data provided a reliable basis for evaluating the overall effectiveness of the implemented pedagogical approach at the next stage of the study. After repeated testing, a comparison of the results with those of the initial assessment revealed a clear improvement in the participants' performance. The post-experimental test demonstrated higher scores among the cadets (from 62.4 to 81.7 points in the experimental group; +30.9%, compared to +12.8% in the control group), indicating that the integration of gamification elements into the learning environment contributed to a better understanding of the educational material and increased motivation to complete course activities (Fig. 7).

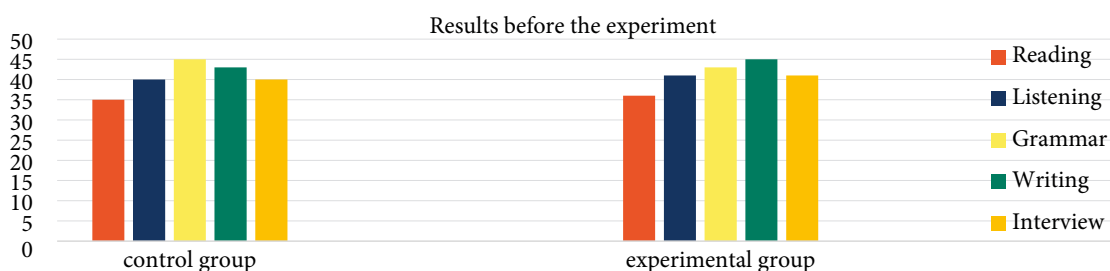


Figure 6. The results of both groups

Source: created by the author

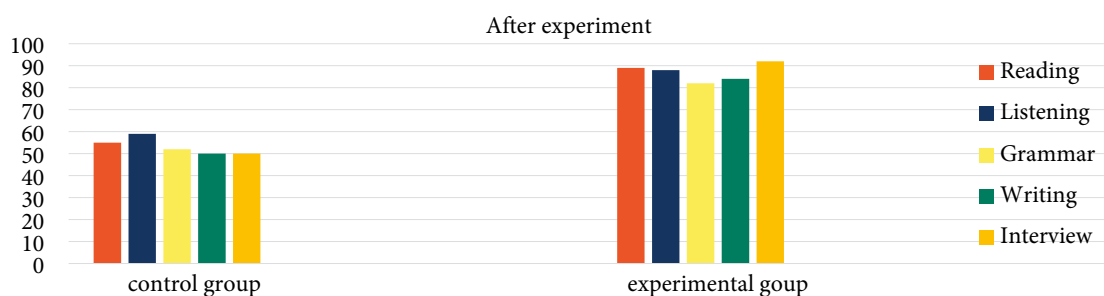


Figure 7. Post-experimental results of the control and experimental groups

Source: created by the authors

Almost all cadets of EG have received the improvements of their marks after the experiment. As shown in Figure 7, the experimental group demonstrates significantly higher results in all assessed language skills compared with the control group. The most noticeable differences can be observed in Reading, Writing, and Interview, where the

experimental group achieved results close to 85-90 points, while the control group remained at approximately 50-55 points. Similar differences are also evident in Listening and Grammar, where the experimental group reached around 70-75 points, whereas the control group scored about 45-50 points. The most significant improvements were observed

in speaking (+34%) and listening (+31%) skills. The proportion of cadets who showed no improvement was lower in the experimental group (6.9%) compared to the control group (14.5%).

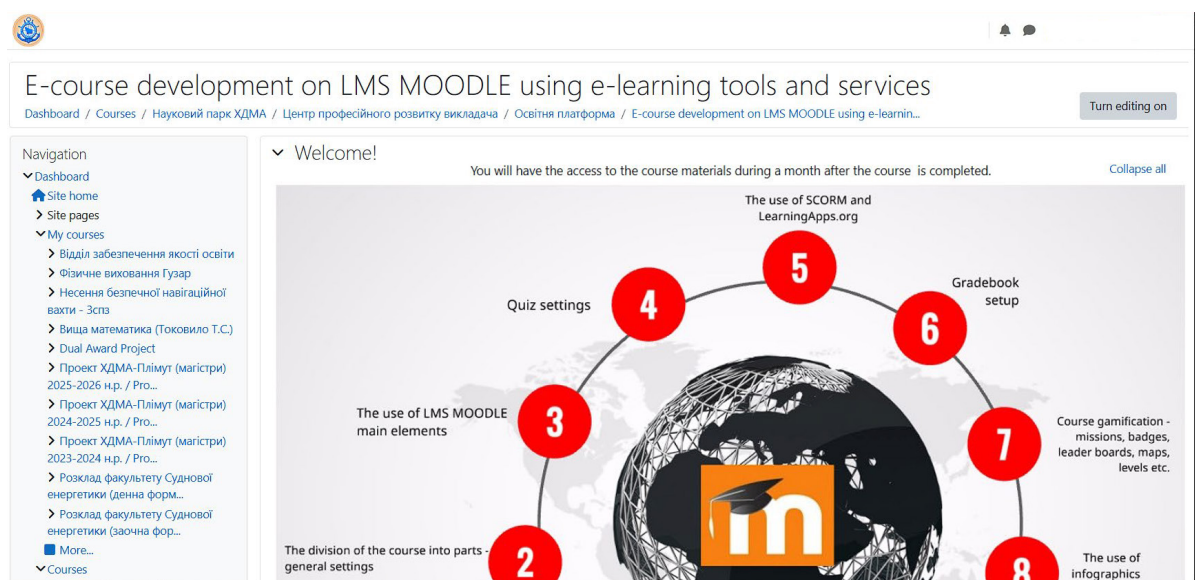
Making learning enjoyable gamification has shifted students' motivation toward extrinsic rather than intrinsic. The greatest impact on the development of individual language skills were done by Leaderboards and Missions with Levels. The feedback about this and explanations of the obtained results was received by the teachers involved. The implementation of gamification positively influenced on students' results as it had increased students' sense of competence and gave them more control over learning process. According to teachers' observations gamification elements like Leader boards, Missions with Levels, Map and Scores had the biggest influence on students' engagement.

Such results indicate that the cadets in the experimental group showed a substantial improvement in their language skills after the implementation of the proposed teaching approach, while the control group demonstrated only moderate progress. The findings suggest that the integration of innovative teaching methods and digital tools, particularly gamification elements and interactive learning activities, had a positive impact on cadets' engagement in the learning process. In addition, these tools supported the development of their communicative competence in Maritime English, encouraged more active participation in course tasks, and contributed to the overall effectiveness of training within the framework of maritime education.

Despite all the advantages listed above gamification has a list of disadvantages and challenges associated with its implementation. In some cases, cadets may become overly

focused on earning rewards rather than engaging with the content for its intrinsic value. This can lead to superficial engagement and a lack of deep understanding. Gamification might initially boost engagement, but the novelty can wear off over time. If the gamified elements are not consistently updated or if learners lose interest, engagement levels may decline (Fazio, 2024). According to the researcher J. Xiao (2022) who investigated potential negative impact of gamification education it was also found that short-term gamification teaching with a total duration of less than 21 days and gamification teaching with rewards may be disadvantageous to some student groups, which are mainly introverts. By the end of the experiment conducted by teachers of KSMA it could be approved as the questionnaire also had some questions about students' traits of character and it is connected to their study results.

Scientist S. Liberty (2023) made a research of when and how is gamification harmful. The researcher concluded that it can easily do more harm than good because it is important to use it properly. Teachers of KSMA had the training in the Lifelong Learning Center (courses "E-course development on LMS MOODLE using e-learning tools and services" and "Blended learning as an innovative form of organising the educational process at educational institutions" which included modules on gamification). In case of incorrect use of gamification its effect can harm students' motivation, scores etc. The course "E-course development on LMS MOODLE using e-learning tools and services" is bilingual (for English teachers it is in English and in Ukrainian for others). The part of the course is shown below (Fig. 8). The module about gamification is called "Course gamification – missions, badges, leaderboards, maps, levels etc".



**Figure 8.** E-course development on LMS MOODLE using e-learning tools and services

Source: Lifelong Learning Center (n.d.)

The obtained results demonstrated consistent positive dynamics across all measured indicators, including

motivation, activity, and academic performance, which confirms the effectiveness of gamification in the

educational process. Pros, cons, and practical insights of gamification in education were investigated by J. Ladouceur (2024). The author concluded with the following cons of gamification in learning: risk of extrinsic motivation over internal motivation; potential for competition-induced stress. The results of KSMA's teachers experiment have the same because in Maritime English cadets may also focus on "getting points" instead of mastering communication skills critical for their safety on board vessel.

Scientists J. Rokhmat *et al.* (2025) revealed the weaknesses of applying gamification in science learning and overcoming it: a systematic review. They concluded that gamification has to be applied enticingly and thrillingly to students and contains game mechanics that apply to the situation matter. The same approach was used while pedagogical experiment at KSMA, the results of which confirmed the conclusions of the mentioned above scientists.

Negative effects of gamification in education software were studied by C. Almeida *et al.* (2022). The group of scientists proved that the gamification, when improperly applied, can have negative effects on education/learning software. Although positive effect of gamification after the experiment at KSMA have been also proved. Other gamification problems were identified by J. Jenkins (2025). The researcher described four main problems and ways of their avoiding. Teachers of KSMA involved in the experiment have used the tips on gamification problems avoiding while experiment and in their teaching on regular base. One of the most popular is considered to be not connecting the game to a learning objective of the lesson/module.

The Master Thesis on the negative effect of gamification in e-learning in the eyes of university students was written by Q. Dung Phung (2020). The following negative effects were analysed (demotivation, stressful, etc.). The researcher also agreed that gamification could be a meaningful way to increase student motivation and improve the educational effectiveness of online courses. Another challenges of gamification in enhancing student learning outcomes were analysed by D.R. Wulan *et al.* (2024). They concluded that gamification can be a powerful tool for improving student learning outcomes when applied thoughtfully, with attention to the diverse needs of learners and the educational context. The results of this study agree on D.R. Wulan's findings and prove the positive results in case of appropriate use of gamification by teachers. The ways on how gamification can hinder genuine learning were analysed by B. Jose *et al.* (2024). The following risks were analysed by group of scientists: surface-level engagement, stress, and inclusivity challenges. To mitigate these risks scientists, propose to use regular assessments of student engagement and wellbeing. In the experiment conducted at KSMA regular assessments are also an important part of learning process.

In the application of digital gamification approaches in teaching and learning the following challenges were highlighted by K. Muruga & K.A. Jamaludin (2025). The unequal digital access, varying levels of motivation, and

differing cognitive readiness were analysed by explorers. They concluded that the digital access gap, differences in learning preferences, varying cognitive maturity levels, and uneven motivation negatively impact the effectiveness of gamification in enhancing student engagement and academic achievement. The same barriers were described by E.B. Sabornido *et al.* (2022). They reinforced the idea that knowing the challenges and barriers will help implementors of gamification to strategise in overcoming these obstacles. The authors agreed on the conclusions of the scientists mentioned above.

## CONCLUSIONS

The results of the study confirmed that the integration of gamification elements – such as maps, points, leader boards, digital badges, game-based activities, progress indicators, levels, and missions – constitutes an effective pedagogical strategy for creating a dynamic and engaging learning environment for cadets during Basic Safety training on LMS Moodle, particularly under the challenging conditions of martial law in Ukraine. The implementation of these elements significantly enhanced the interactivity of the learning process and increased cadets' motivation. In particular, questionnaire results indicated that 78% of cadets reported increased interest in learning, while 71% demonstrated higher levels of intrinsic motivation. Moodle analytics further confirmed a 37% increase in overall learning activity, a 42% increase in task completion rates, and a 29% increase in independent work engagement.

The findings also demonstrated a positive impact of gamification on both learners' engagement and academic performance. The average post-test score in the experimental group increased from 62.4 to 81.7 points (+19.3 points; +30.9%), compared to a smaller improvement in the control group (+8.1 points; +12.8%). The most significant gains were observed in speaking (+34%) and listening (+31%), indicating the effectiveness of interactive and scenario-based learning activities. Cadets were able to monitor their progress, compare their achievements with peers, and maintain sustained motivation throughout the course. A positive correlation ( $r = 0.64$ ) between motivation levels and learning outcomes further confirms the relationship between engagement and performance. Additionally, the proportion of cadets who showed no improvement was lower in the experimental group (6.9%) compared to the control group (14.5%), which indicates a more consistent learning effect.

Furthermore, the study highlighted the considerable potential of gamification within maritime education, particularly in safety training contexts, where maintaining attention, engagement, and practical readiness is of critical importance. Overall, the integration of gamified online courses ensures a more effective, interactive, and learner-centred educational experience for future seafarers in a modern digital learning environment, providing both measurable academic gains and sustainable motivational outcomes. The prospects for future research lie

in expanding the use of advanced digital learning technologies, such as virtual reality, augmented reality, and mixed reality, in the training of future maritime professionals, including navigators, ship engineers, and electrical engineers. These technologies may further enhance the realism of training scenarios, improve practical skill development, and strengthen the overall effectiveness of maritime education.

None.

None.

None.

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## CONFLICT OF INTEREST

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### **Дослідження ролі гейміфікації у підвищенні залучення морських фахівців до навчання**

**Анотація.** Цифровізація та вимоги до навчання роблять дедалі важливішим підвищення залученості студентів-моряків. Гейміфікація вважається інноваційним підходом, який сприяє інтенсифікації освітньої діяльності та підвищує ефективність професійної підготовки морських спеціалістів. Метою дослідження було вивчення ролі гейміфікації у підвищенні залученості до онлайн-курсів підготовки моряків. Методологія дослідження ґрунтувалася на поєднанні комплексу взаємопов'язаних теоретичних (аналіз, синтез, узагальнення, порівняння) та емпіричних методів (педагогічний експеримент, спостереження, анкетування, тестування), що забезпечило всебічне вивчення процесу підготовки майбутніх судномеханіків в умовах цифрового навчального середовища. У дослідженні проаналізовано можливості використання гейміфікації в електронному навчанні майбутніх морських фахівців на платформі LMS Moodle. Встановлено, що впровадження елементів гейміфікації, зокрема карт, балів, таблиць лідерів, цифрових бейджів, ігрових вправ, індикаторів виконання завдань, рівнів і місій, сприяє підвищенню зацікавленості та залученості курсантів до навчального процесу. Розроблено гейміфікований онлайн-курс з дисципліни «Безпека життєдіяльності», який містить навчальні матеріали з особистої безпеки, пожежогасіння, виживання та надання першої медичної допомоги. Описано практичний досвід створення елементів гейміфікації як у середовищі LMS Moodle, так і на зовнішніх веб-ресурсах з подальшою їх інтеграцією у навчальний курс. Встановлено, що використання гейміфікації формує більш динамічне навчальне середовище та позитивно впливає на мотивацію і навчальну активність здобувачів освіти. У результаті дослідження доведено, що гейміфіковані онлайн-курси підвищують ефективність навчання та покращують загальний освітній досвід майбутніх морських фахівців. Перспективи подальших досліджень вбачаються у використанні інших цифрових інструментів електронного навчання (наприклад, віртуальної реальності, доповненої реальності, змішаної реальності) під час вивчення дисципліни «Основи безпеки життєдіяльності» майбутніми морськими фахівцями (судноводіями, судновими механіками, електромеханіками)

**Ключові слова:** морська освіта; персоналізований простір; електронне середовище; електронне навчання; суднові механіки

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## Emotional intelligence and its impact on the effectiveness of decision-making under time constraints

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**Abstract.** The aim of the study was to determine the patterns of influence of the level of emotional intelligence development on the quality and speed of decision-making in situations with time constraints. To achieve this aim, the methods of systems analysis, generalisation of scientific approaches to the study of emotional intelligence, logical-theoretical modelling of the decision-making process under time constraints, and elements of quantitative analysis for structuring the obtained results were used. The results of the study showed that the ability to recognise and manage one's own emotions increases the accuracy of decision-making within limited time frames. The analysis of scientific works also demonstrated that emotional intelligence plays an important role in maintaining the stability of cognitive processes under increased informational and time pressure. It was found that a low level of emotional intelligence is associated with increased impulsivity, cognitive overload, reduced accuracy in risk assessment, and difficulties in making structured decisions. The analysis showed that the development of emotional resilience and the capacity for self-regulation contributes to more effective forecasting of the possible consequences of alternative actions, optimal allocation of attentional resources, and a reduction in the impact of stress and overload on the quality of decisions made. Moreover, the integration of cognitive and emotional components of emotional intelligence ensures adaptability in complex and dynamic conditions, increasing both the accuracy and speed of choice even under limited time. Such a comprehensive approach made it possible to consider emotional intelligence as a multi-level regulatory mechanism that forms a stable foundation for effective decision-making across various fields of professional activity. The practical value of the study lies in the possibility of applying the obtained results to improve training programmes for the development of emotional competence, to prepare specialists for work under stressful conditions, and to optimise decision-making processes in the fields of education, management, medicine, entrepreneurship, and other activity contexts in which time constraints are a constant factor

**Keywords:** cognitive stability; emotional self-regulation; decision accuracy; stress load; adaptive strategies; decision-making

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## INTRODUCTION

During the period 2020-2025, which was characterised by increasing dynamism in social, economic and professional environments, the problem of decision-making under time constraints became particularly relevant. The acceleration of the pace of life, the intensification of work processes, the growth of cognitive load and

increased uncertainty required individuals to be able to quickly assess situations and make effective decisions within a limited time frame. Researchers consider emotional intelligence (hereinafter referred to as EI) to be one of the important psychological factors that determined the quality of such decisions.



Scientists argue that decision-making under time constraints remains a critical issue in various professional fields. Thus, R. Hasson Marques *et al.* (2024) noted that a high level of emotional competence among managers significantly improves strategic thinking in rapidly changing and uncertain situations. Similar conclusions were reached by I. Rafiq *et al.* (2022) in the medical field: employees with developed EI demonstrated lower stress levels and made more accurate decisions during intense workloads. These results are consistent with the findings of Z. Guo & Q. Wang (2025), who showed that time pressure leads to a narrowing of the cognitive field and an increased risk of errors, but high EI partially compensates for these effects. J. Samu *et al.* (2025), in a systematic review of studies of safe and risky environments, further emphasised that emotional intelligence is a psychological buffer, mitigating the effects of stress and cognitive overload.

Analysis of scientific findings has revealed common patterns and specificities of EI's influence on decision-making. The works of D. Tkachenko (2025) show that individual characteristics of emotional and cognitive regulation affect the speed of psychological resource recovery, which directly determines the effectiveness of decisions in stressful situations. M. Smorshchok (2025) emphasised the role of emotional processes in maintaining adaptive behaviour and mental stability, which also indirectly affects the quality of professional decisions.

Additionally, empirical studies demonstrate the specificity of EI's influence in various fields of activity. A. Ayed (2025) showed that medical workers in neonatal wards with high EI levels made more accurate and informed clinical decisions when time was limited. N. Rodrigues & C. Matos (2024) noted the positive impact of managers' EI on the quality of project decisions in multitasking conditions, and S. Munir *et al.* (2025) demonstrated that the development of emotional competence in educational organisations increases the effectiveness of management decisions in stressful situations. Despite a significant number of scientific studies, the mechanisms of emotional intelligence's influence on decision-making processes in situations of acute time constraints remained insufficiently researched. Most of the available studies focused on specific professional groups or examined emotional intelligence outside the context of time constraints, which created the need for a comprehensive theoretical generalisation of this issue.

The aim of the article was to investigate the influence of emotional intelligence on the effectiveness of decision-making under time constraints, taking into account theoretical concepts and the results of empirical studies published in 2020-2025. To achieve this aim, the following objectives were formulated: (1) to generalise scientific approaches to understanding emotional intelligence and decision-making mechanisms; (2) to analyse the results of studies on the relationship between EI and behaviour under time pressure; (3) to identify the main emotional and cognitive factors that influenced the quality of decisions. The scientific novelty of the work lies in the

systematisation of research conducted in 2020-2025 and the conceptual generalisation of the role of emotional intelligence in decision-making situations under time pressure, as well as in the identification of emotional characteristics that performed a protective or moderating function in relation to stress and cognitive overload.

## MATERIALS AND METHODS

The methodological basis of the study consisted of general scientific methods and methods of logical-structural analysis, synthesis and comparison, which allowed for a comprehensive analysis of the influence of EI on decision-making processes under time constraints. The work used methods of theoretical analysis and synthesis to systematise scientific approaches to the interpretation of EI, in particular its cognitive, emotional and behavioural components, which became the methodological basis for constructing the author's model. The method of comparative analysis of theoretical and empirical studies was used to identify common and distinctive provisions in the works of foreign and Ukrainian researchers who studied the role of emotional intelligence, time pressure and stress factors in the decision-making process (Rafiq *et al.*, 2022; Liu *et al.*, 2023; Hasson Marques *et al.*, 2024).

An important element of the study was the application of logical-theoretical modelling, which was used to construct an integrative logical-theoretical model of the influence of EI on the effectiveness of decision-making under time pressure. Within this approach, EI was considered as a multi-level regulatory mechanism that combines emotional, cognitive, and behavioural components in the decision-making process. The model was built based on a generalisation of the results of modern theoretical and empirical studies and allowed to identify the main links between EI components and the quality of decisions in time-constrained situations. To detail these relationships, the study used logical-structural methods of classification and typology, which made it possible to identify the main mechanisms of emotional intelligence's influence on the decision-making process. In particular, regulatory, cognitive and socio-perceptual mechanisms were classified, and the conditions under which time pressure most significantly affects the quality of choice were typologised. The selection of emotional, cognitive and behavioural components for inclusion in the model was based on the principle of theoretical representativeness and repeatability of results in contemporary studies from 2020 to 2025. The model included those components that, in various conceptual approaches (ability-based, trait-based, and integrative (mixed)), were systematically associated with the quality and speed of decision-making under time pressure.

Emotional components (emotional awareness, regulation, and stress resistance) were selected based on their proven role in reducing the negative effects of stress and cognitive distortions in time-deficit situations (Rafiq *et al.*, 2022; Ayed, 2025; Guo & Wang, 2025). Cognitive components (selective attention, cognitive flexibility, risk

assessment) were identified as important based on studies demonstrating their sensitivity to time pressure and direct impact on choice accuracy (Liu *et al.*, 2023; Samu *et al.*, 2025). Behavioural components (impulse control, adaptive action strategies) were included in the model as an external manifestation of the integration of emotional and cognitive processes in real-life decision-making conditions. The interrelationships between the components were determined through integrative analysis of empirical data, which allowed to establish stable links between the level of emotional intelligence development, the nature of cognitive processes, and behavioural choice strategies under time constraints. This approach ensured the logical consistency of the model and its compliance with modern theoretical ideas about the multilevel nature of emotional intelligence. This made it possible to systematise heterogeneous scientific data and present it in a structured and logically ordered form.

The identification of typical conditions of heightened sensitivity to time pressure was based on a systematic analysis of empirical studies from 2020 to 2025, in which time constraints were considered as an independent or moderating variable in the decision-making process and their impact on the quality of choice was assessed. The criteria for identifying such conditions were: (1) the stability of the negative impact of time pressure on decision accuracy; (2) the repeatability of effects in different professional contexts; (3) the presence of described psychological mechanisms through which time constraints changed the cognitive and emotional dynamics of choice. On this basis, typical conditions of increased sensitivity to time pressure were identified, including high stress levels, multitasking, information uncertainty, emotional tension, the need for quick responses, and situations of increased responsibility and risk. Their classification was based on the nature of the dominant load (emotional, cognitive, or social) and the specifics of the disturbances that arise in the process of decision-making under time constraints.

The study was based on a systematic analysis of scientific publications from 2020-2025 devoted to the issues of EI, time pressure and decision-making. The literature search was conducted in the international scientometric databases Scopus, Web of Science, PubMed, PsycINFO, as well as in the open scientific repositories Google Scholar and ResearchGate. The sources were selected based on the following criteria: scientific novelty and relevance; relevance to the research topic; publication in peer-reviewed scientific journals; presence of a clearly defined methodology; representativeness of results for various professional fields (medicine, security, management, sports, behavioural economics). This approach ensured the reliability and theoretical validity of the generalisations and conclusions made. In addition, the work used integrative analysis based on psychological, cognitive and behavioural approaches, which made it possible to combine psychological, cognitive, managerial and behavioural approaches to the study of decision-making. This made it possible to extrapolate

the identified patterns to various professional contexts and identify universal mechanisms of the compensatory role of EI in conditions of time deficit. The results were structured using tables and a logical-theoretical model reflecting the relationship between EI components, cognitive processes and the effectiveness of decision-making under time pressure. These methodological approaches ensured the logical consistency of theoretical propositions, the validity of generalisations, and the reproducibility of the scientific results obtained within the chosen research model.

## RESULTS AND DISCUSSION

### **Theoretical approaches to understanding the role of emotional intelligence in decision-making under time constraints**

Decision-making processes under tight time constraints are characterised by increased cognitive load, growing uncertainty and heightened emotional reactions, which significantly affect the quality of choices. In such situations, the effectiveness of decisions is increasingly determined not only by the level of professional training, but also by the ability of the individual to regulate their own emotional states, maintain cognitive stability, and quickly adapt to changing conditions. In view of this, the analysis of the role of EI as a regulatory mechanism for decision-making under time pressure is of particular scientific importance and requires a thorough theoretical understanding in the context of contemporary research.

In scientific works from 2020-2025, EI was defined as an important personal ability that ensures effective interaction with a dynamic and information-rich environment (Dhiman & Kumar, 2023; Khotynska, 2024). Its importance is particularly evident in situations where decisions must be made quickly, in conditions of uncertainty and increased emotional pressure. It is at such moments that a person's ability to recognise their own emotions and those of others, manage them and use them as a resource to maintain cognitive clarity and rationality is manifested (Smorshchok, 2025; Tkachenko, 2025). Contemporary research from 2020-2025 interprets emotional intelligence within ability-based, trait-based, and integrative (mixed) conceptual approaches, each of which places different emphasis on the roles of emotional and cognitive components in processes of self-regulation and decision-making under time pressure (Hasson Marques *et al.*, 2024; Samu *et al.*, 2025; Queiroz-Ribeiro *et al.*, 2025).

The ability-based approach considers EI as a specific cognitive ability to recognise emotional signals, integrate emotional information into the thinking process, be aware of emotional dynamics and consciously regulate one's own emotional states. This approach emphasises that effective decision-making under time constraints depends significantly on the ability to maintain cognitive clarity and control emotional responses (Liu *et al.*, 2023; Guo & Wang, 2025). The trait-based approach interprets EI as a relatively stable set of personality characteristics manifested in the level of emotional sensitivity, stress

resistance, social confidence, and propensity for self-regulation. Studies in this area have shown that individual differences in emotional stability determine sensitivity to time pressure and a tendency to make impulsive or erroneous decisions (Rafiq *et al.*, 2022; Lama & Brenlla, 2023; Ayed, 2025). Integrative (mixed) models of emotional intelligence combine cognitive, emotional, and behavioural components and view EI as a set of competencies that ensure behavioural adaptability in conditions of stress, uncertainty, and time constraints. Contemporary review and applied studies emphasise that it is the integration of emotional regulation, empathy, and cognitive flexibility that allows for increased accuracy and speed in making managerial, clinical, and risk-oriented decisions (Rodrigues & Matos, 2024; Dwivedy *et al.*, 2025; Salameh-Ayanian *et al.*, 2025).

Along with this, mixed models of EI are widespread, the most famous of which is D. Goleman's model, where EI is presented as a combination of cognitive components with motivational and behavioural characteristics. These components include empathy, adaptability, self-control, social responsibility, and the ability to build effective interactions with others. In these models, EI is viewed not

only as the ability to process emotional information, but as a broader set of competencies that determine the effectiveness of an individual's behaviour under stress and time constraints. Mixed approaches are also based on the ideas of R. Bar-On, who includes emotional awareness, stress resistance, interpersonal sensitivity, and self-regulation in the structure of EI. In the context of decision-making, those elements of EI that directly affect the speed and accuracy of situation assessment play a special role. These are, first of all, the level of emotional awareness, which allows one to quickly recognise both internal experiences and signals from the external environment; the ability to regulate emotional reactions, thereby reducing the impact of stress and cognitive distortions; and the ability to quickly adapt to changes and predict the possible consequences of different courses of action. The combination of these characteristics forms a holistic cognitive-regulatory mechanism that determines the quality of decisions made in conditions of uncertainty and limited time. An analysis of scientific sources published in 2020-2025 revealed several conceptual interpretations of the role of EI in decision-making under time constraints. Table 1 summarises the main findings of studies conducted in 2020-2025.

**Table 1.** Scientific approaches to the study of the influence of emotional intelligence on decision-making under time constraints

Author(s), year	Field of study	Main findings	Relevance to the topic of the article
R. Hasson Marques <i>et al.</i> (2024)	Strategic decisions in management	Emotions and EI shape the quality of decisions in complex conditions; EI acts as a cognitive regulator.	Confirms the role of EI in complex, multifactorial decisions
I. Rafiq <i>et al.</i> (2022)	Stress, time constraints, overload	High EI reduces stress under time pressure and improves the quality of professional decisions.	Shows the compensatory effect of EI in situations of acute time shortage
Z. Guo & Q. Wang (2025)	Sports decisions under time pressure	Time pressure worsens decision accuracy; the ability to achieve emotional stabilisation plays an important role.	Demonstrates the mechanism of emotional regulation in high-speed decision-making
J. Samu <i>et al.</i> (2025)	Security professions, risk	EI influences risk-related decisions in critical situations and improves the accuracy of risk assessment.	Confirms the importance of EI in high-risk environments
A. Ayed (2025)	Clinical decisions under stress	High EI improves clinical decisions under conditions of uncertainty and time constraints.	Illustrates the application of EI in high-responsibility medical settings
J. Freedman <i>et al.</i> (2025)	Organisations, personnel decisions	A global decline in EI has negatively affected the quality of managerial decisions.	Shows the strategic consequences of low EI
M. Salameh-Ayanian <i>et al.</i> (2025)	Management in turbulent conditions	EI improves managers' decisions in turbulent and rapidly changing conditions.	Consistent with the thesis on the role of EI in stressful time conditions
N. Rodrigues & C. Matos, 2024	Project management	EI influences the quality of managerial decisions in complex projects.	Confirms the universality of EI in different types of decisions
D. Dwivedy <i>et al.</i> (2025)	High-risk teams	EI accelerates recovery after incidents and reduces the number of erroneous decisions.	Reflects the relationship between EI and the stability of decisions under pressure
Z. Liu <i>et al.</i> (2023)	Neurocognitive mechanisms of decisions under time pressure	Time pressure activates the brain's emotional system, which affects prosocial decisions.	Provides neurophysiological confirmation of the influence of emotions on decisions
S. Alinejad <i>et al.</i> (2025)	Consumer behaviour	Time pressure worsens the quality of choice; EI moderates the negative effect.	Provides data on behavioural decisions

**Source:** compiled by the authors

A summary of the approaches presented in Table 1 shows that EI is not only a psychological characteristic but also an important cognitive-regulatory mechanism that directly influences the quality of choices in stressful and time-limited situations. Understanding this mechanism allows to reinterpret human behaviour under time pressure: not as a chaotic reaction to external stimuli, but as a structured process in which emotional regulation plays a leading role. It is the development of emotion management skills that determines the extent to which an individual is able to maintain concentration, control impulsive reactions, and preserve consistency of thought. The development of this idea is made possible by a systematic analysis of contemporary scientific publications, which has allowed to identify the main patterns of EI's influence on the effectiveness of decision-making in situations where time is limited. Emotional competence functions as a multi-level moderator that simultaneously influences cognitive processes (evaluating alternatives, processing information, predicting consequences) and behavioural responses (restraining impulsivity, choosing a strategy for action, adapting to unpredictable circumstances). This dual role of EI explains why, even with the same level of professional training, different individuals demonstrate different results under severe time constraints. This is because individuals differ significantly in a number of psychological parameters that determine the speed and quality of decision-making.

In particular, studies show that temperament, speed of cognitive information processing, propensity for impulsivity, stress resistance, and the ability to stabilise emotions shape different levels of sensitivity to time pressure (Liu *et al.*, 2023; Guo & Wang, 2025). People with high EI are able to control their emotional reactions more effectively, maintain cognitive clarity, and reduce the influence of impulsive decisions, while individuals with lower emotional regulation are more likely to demonstrate slower analytical processing of information and an increase

in the number of errors (Rafiq *et al.*, 2022; Alinejad *et al.*, 2025). It is these individual differences that explain why time constraints are not equally critical for everyone and why EI is a significant moderator of effective behaviour in time-constrained situations. Thus, current research confirms that EI is an important cognitive-regulatory mechanism that ensures adaptability and accuracy of decision-making under time pressure.

### Psychological conditions and mechanisms of decision-making under time pressure: the compensatory role of emotional intelligence

In situations where time for reflection is severely limited, the structure of decision-making undergoes significant transformations: cognitive processes accelerate, and rational strategies are replaced by more economical mental schemas. At the same time, emotional reactions become an important factor determining the quality of the actions chosen. That is why understanding the nature of the psychological mechanisms that are activated under time pressure, as well as the external and internal factors that complicate the selection process, is crucial for explaining how EI affects the effectiveness of decision-making. In the context of studying the impact of time constraints on the decision-making process, it is important not only to identify general patterns of stress, time deficit and cognitive load, but also to identify the specific conditions under which these factors are most critical. A summary of the results of interdisciplinary studies shows that the combination of time constraints with stressful, informationally unstable or multitasking situations significantly changes the dynamics of cognitive processes and the quality of choice. An integrative (mixed) analysis of such conditions is presented in Table 2. It allows to systematise the relationships between the nature of the load, the consequences for cognitive activity, and the compensatory role of EI, which can be traced in empirical studies from 2020 to 2025.

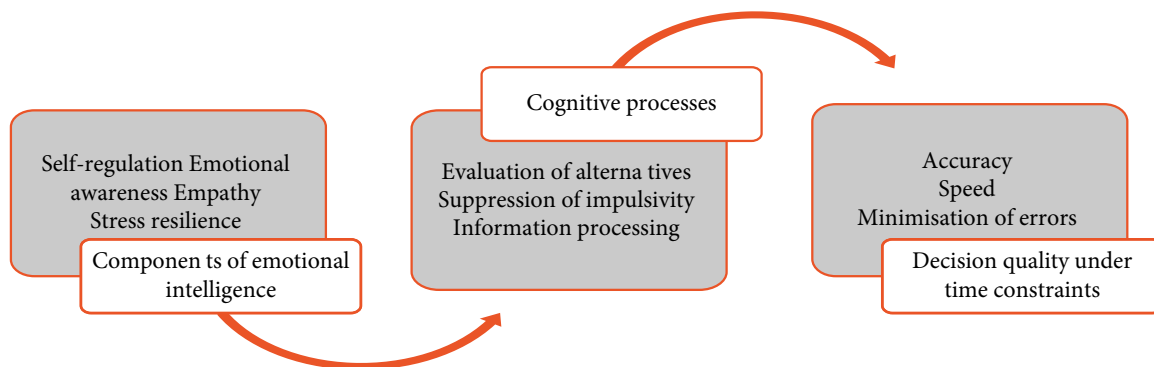
**Table 2.** Integrative (mixed) analysis of the conditions under which time constraints have the greatest impact on decision-making

Condition	Consequences for cognitive activity	Compensatory role of EI
High stress	Decreased accuracy, impulsive decisions, cognitive impairments	Regulation of emotions, stabilisation of attention
Multitasking	Overload, slowed information processing	Maintaining cognitive efficiency through emotional self-regulation
Lack of information	Distorted risk assessment, errors in choice	Reducing anxiety, increasing the accuracy of intuitive decisions
Emotional tension	Emotional reactions prevailing over rational ones	Optimisation of the assessment process through emotional awareness
Requirement for quick reactions	Decreased accuracy, automated actions, increased number of errors	Support for cognitive flexibility and suppression of impulsivity
High responsibility and risk	Increased likelihood of critical errors	Improvement in the quality of risk assessment
Organisational turbulence	Decreased strategic stability of decisions	Support for adaptability and control of emotions

**Source:** developed by the author based on I. Rafiq *et al.* (2022), Z. Liu *et al.* (2023), R. Hasson Marques *et al.* (2024), N. Rodrigues & C. Matos (2024), A. Ayed (2025), M. Shahmari *et al.* (2025), J. Samu *et al.* (2025), S. Munir *et al.* (2025), S. Alinejad *et al.* (2025), Z. Guo & Q. Wang (2025), D. Dwivedy *et al.* (2025), J. Samu *et al.* (2025), P. Queiroz-Ribeiro *et al.* (2025), M. Salameh-Ayanian *et al.* (2025)

An analysis of the conditions listed in Table 2 shows that time pressure has the most significant negative impact in situations where it is combined with high levels of stress, multitasking, information uncertainty, or increased responsibility. In such contexts, EI plays an important compensatory role, ensuring stabilisation of attention, control of impulsivity, increased accuracy of risk assessment, and preservation of cognitive efficiency. Summarising these provisions, it is logical to proceed to their conceptual representation in the form of a model. Based on a summary of the results of recent studies, the main components of emotional influence were identified. In particular, I. Rafiq *et al.* (2022) and R. Hasson Marques *et al.* (2024) noted the role of emotional regulation and reactivity in situations

of time deficit. Studies by Z. Guo & Q. Wang (2025) and J. Samu *et al.* (2025) emphasised cognitive processes such as information processing speed and attention focus, which directly affect decision-making effectiveness. Other works, notably by N. Rodrigues & C. Matos (2024), A. Ayed (2025), and D. Dwivedy *et al.* (2025), demonstrated the interrelationship between emotional and cognitive components, emphasising their impact on the accuracy and quality of decisions under time constraints. The results of the systematisation are presented in the form of an integrative logical-theoretical model that demonstrates the interaction between EI elements and the effectiveness of decision-making under time pressure, as well as reflecting the compensatory role of EI in critical situations (Fig. 1).



**Figure 1.** Logical-theoretical model of the influence of EI on the decision-making process under time pressure

Source: developed by the author

Thus, the model clearly demonstrates that EI is not an isolated trait, but an integrated psychological and cognitive mechanism that determines the success of decision-making under time pressure. The interaction of emotional components with cognitive operations has a lasting impact on the accuracy and speed of decisions, reducing the risk of errors in critical situations. This allows EI to be considered an important predictor of professional effectiveness in areas where high workload intensity and time constraints are commonplace. The interaction of emotional regulation, cognitive processes, and time constraints creates a specific environment in which the quality of decision-making significantly depends on the level of EI. A comparison of the psychological mechanisms of EI with the characteristics of rapid choice shows that EI performs a number of functions that significantly change the dynamics of decision-making.

First of all, the ability to regulate emotions reduces the intensity of stress reactions, which in conditions of time deficit usually provoke “tunnel” thinking. Employees with high EI are able to stabilise physiological arousal, which creates conditions for maintaining logical analysis and minimises the risk of cognitive distortions. This is consistent with data from experimental and cognitive psychology, according to which emotional control directly affects working memory, cognitive flexibility, and decision-making speed under stressful

conditions. In particular, studies show that high EI reduces the intensity of stress responses, thereby maintaining more stable working memory and reducing the risk of cognitive distortions (Rafiq *et al.*, 2022; Liu *et al.*, 2023). Z. Guo & Q. Wang (2025) also emphasise that the ability to regulate emotional impulses is directly related to the effectiveness of thinking under time pressure, as emotional stabilisation allows for accurate decision-making even in fast-paced situations.

The second mechanism is related to prioritisation. People with high EI are quicker to identify the important parameters of a situation, avoiding information overload. In time-constrained situations, this effectively acts as an internal “filter”, preventing analysis paralysis and maintaining the effectiveness of heuristic strategies. Thus, EI makes it possible to maintain the quality of decisions even under time constraints, preventing them from deteriorating chaotically. The third important mechanism is the ability to integrate intuitive and analytical processes. Unlike participants with low EI, who tend to either rely too much on intuition or get overly caught up in rational analysis, individuals with high EI demonstrate a balance between the two strategies. They form quick hypotheses but adjust them according to the real parameters of the situation. This ensures more accurate choices even under conditions of extreme time constraints (Stetsenko, 2025). The fourth mechanism manifests itself in interpersonal

situations, in which EI enhances the ability to read other people's emotional signals. Quickly understanding the intentions and potential reactions of partners reduces the likelihood of communication errors and conflicts that often arise in stressful situations. In such situations, EI becomes a resource that compensates for the lack of time to think about social dynamics. Thus, the results show that a high level of EI allows to maintain cognitive efficiency even in complex and stressful situations.

### Functional mechanisms of emotional intelligence in decision-making under time constraints

Summarising the observations, it can be argued that EI not only facilitates the process of accelerated decision-making, but also improves the quality of choices, reducing the risk of errors. Its influence is manifested through the interaction of regulatory, cognitive, and socio-perceptual mechanisms, which makes emotional intelligence one of the key factors of effectiveness under time constraints (Table 3).

**Table 3.** Mechanisms of the influence of EI on decision-making in situations of time constraints

Mechanism	Essence of the mechanism	How it manifests itself under time pressure	Theoretical basis
Emotional regulation	Ability to control the intensity and dynamics of emotional reactions	The risk of tunnel thinking is reduced, logical analysis is maintained, and cognitive flexibility is increased	Stress models (Yerkes-Dodson), research on EI as a regulatory resource
Prioritisation and selective attention	Focus on key parameters, rejection of secondary ones	Information overload is reduced, and the use of relevant heuristics is accelerated	Theories of selective attention, executive functions
Integration of intuitive and analytical processes	Balance between quick assessment of the situation and brief rational analysis	Faster hypothesis formation and real-time decision correction	Dual-process models of thinking (Kahneman, Evans)
Social-emotional reading	Understanding of other people's emotions and intentions	Fewer communication errors, faster prediction of partners' reactions	Theories of social cognition and empathy

**Source:** developed by the author based on I. Rafiq *et al.* (2022), Z. Liu *et al.* (2023), R. Hasson Marques *et al.* (2024), N. Rodrigues & C. Matos (2024), Z. Guo & Q. Wang (2025), J. Samu *et al.* (2025), A. Ayed (2025), D. Dwivedy *et al.* (2025)

An analysis of the mechanisms presented demonstrates that EI forms a multi-level system of psychological support for effective decisions under time constraints. Despite their different nature – regulatory, cognitive and socio-perceptual – all mechanisms are aimed at reducing cognitive load and optimising attention and evaluation processes. This not only to accelerate choice but also to preserve its quality in situations where time pressure usually provokes errors and disorganisation of thinking. Thus, a high level of EI is an important resource that ensures adaptability, control, and stability of cognitive processes in critically limited time conditions. The role of EI varies significantly depending on the specifics of professional activity, the level of emotional load and the nature of responsibility. In the medical field, where decisions are made under time constraints and increased stress, a high level of EI is a determining factor in the accuracy and safety of clinical actions. Medical professionals with developed emotional regulation and self-control skills demonstrate a better ability to quickly assess risks, avoid cognitive errors, and make decisions that meet intensive care standards. Under conditions of overload and time scarcity, their emotional intelligence supports cognitive flexibility and enables them to focus on the most critical aspects of the patient's condition.

In the fields of security and crisis response, the effective use of EI ensures rapid adaptation to risky conditions and minimises the impact of emotional stress on decision-making. Professionals who are able to regulate their own emotions and assess the emotional states of

those around them are quicker to identify priority actions, maintain team coordination, and reduce the likelihood of critical errors in crisis scenarios. In business, management, and behavioural economics, EI is a mechanism for stabilising attention and analytically evaluating alternatives. Managers with high EI are able to balance intuitive and analytical approaches more effectively, which allows to avoid low-quality spontaneous decisions even in situations of severe time constraints (Queiroz-Ribeiro *et al.*, 2025). This approach contributes to increasing the strategic accuracy of choices, optimising resources, and reducing the risk of impulsive decisions that can negatively affect organisational processes. In sports, where decisions often need to be made in less than a second, the influence of EI manifests itself through the integration of emotional and cognitive components. Athletes with high EI levels are more effective at controlling their emotional reactions, assessing situations more quickly, and choosing the optimal course of action even when time is extremely limited. This confirms the universal nature of EI mechanisms, which increase the accuracy and speed of decision-making not only in high-risk professions, but also in areas where reaction speed is critically important. Thus, in practice, a high level of EI acts as a universal resource that increases the effectiveness of decision-making in areas where time pressure and emotional stress are determining factors. EI provides cognitive and emotional stability, optimises prioritisation and attention processes, and allows adaptation to complex and dynamic conditions, which directly improves the quality and safety of decisions.

### Comparison of the results obtained with previous studies

The results obtained indicate that EI plays an important role in ensuring effective decision-making under time constraints, performing the function of a cognitive-regulatory mechanism. In particular, the results of this study showed that the ability to regulate emotions, awareness of one's own emotions, and control of impulsive reactions contribute to maintaining cognitive clarity and accuracy of choice even under time constraints. This interpretation is consistent with the provisions of modern psychological models, in which EI is considered a resource for adaptation to complex and dynamic conditions of activity. Similar conclusions were obtained in studies of managerial activity. In particular, R. Hasson Marques *et al.* (2024) noted that the emotional competence of managers directly influenced the quality of strategic decisions in situations of high uncertainty and rapid decision-making. The results of this study confirm these findings, demonstrating that high EI contributed to better evaluation of alternatives and reduced cognitive distortions under time pressure.

In the healthcare sector, the results also correlate with previous empirical studies. I. Rafiq *et al.* (2022) found that healthcare professionals with high emotional intelligence demonstrated lower stress levels in conditions of work overload and made more accurate clinical decisions. Similarly, A. Ayed (2025) showed that in neonatal wards, high EI contributed to more informed decisions under critically limited time constraints. The results obtained in this study are consistent with these findings, confirming the compensatory role of EI in situations of increased responsibility. Research by S. Jaboob *et al.* (2025) further showed that the psychological well-being of medical and entrepreneurial groups also moderates the effectiveness of decision-making under workloads and time constraints. At the same time, the results of the study deepen the understanding of the impact of time pressure on cognitive processes. Thus, Z. Guo & Q. Wang (2025) proved that time constraints reduced the accuracy of decisions and led to a shift to intuitive strategies. The results of this study complement these findings, showing that emotional stabilisation mitigates the negative impact of such a shift by maintaining a balance between intuitive and analytical components of thinking.

The neurocognitive mechanisms of decision-making under time pressure described by Z. Liu *et al.* (2023) confirmed that time constraints activate the emotional systems of the brain, which influences the nature of choices. The results of this study are consistent with these data, demonstrating that high EI allows for more effective integration of emotional signals into the cognitive processing process, reducing the risk of impulsive decisions. In the context of high-risk and safety-critical professions, J. Samu *et al.* (2025) showed that EI performs a moderating function with regard to the propensity for risky decisions. Similar patterns were found in this study: the results show that EI contributes to stabilising attention and improving the accuracy of risk assessment under time constraints. Similar

conclusions are confirmed by data from D. Dwivedy *et al.* (2025), who established a link between EI and the effectiveness of team recovery after incidents. The results of the study are also consistent with findings in the fields of management and education. N. Rodrigues & C. Matos (2024) demonstrated that high levels of EI among managers had a positive impact on the quality of management decisions in project activities. In addition, S. Munir *et al.* (2025) showed that the development of emotional competence in educational organisations contributed to improving the effectiveness of management decisions under high stress conditions. Furthermore, the study by M. Salameh-Ayanian *et al.* (2025) emphasised the importance of EI for employee productivity in turbulent conditions, deepening the understanding of the universality of these patterns in different professional environments. The results confirm the universality of these patterns in different professional contexts. Thus, the results of this study generally confirm and at the same time complement current scientific ideas about the role of EI in decision-making processes under time pressure. Unlike a number of previous works, this study focuses on the integrative nature of EI as a mechanism that simultaneously influences the cognitive, emotional, and behavioural components of choice. This allows to consider EI not only as a separate psychological characteristic, but as a systemic resource that ensures the adaptability and stability of decision-making in complex and rapidly changing conditions. Thus, the results obtained are consistent with previous studies, confirming that EI functions as a cognitive-regulatory mechanism that increases the accuracy and speed of decision-making in stressful conditions.

### CONCLUSIONS

The conducted study made it possible to comprehensively analyse the role of emotional intelligence in the decision-making process under time constraints and to identify the main mechanisms through which it influences the effectiveness of cognitive activity. The generalisation and comparative analysis of scientific approaches showed that emotional intelligence is not only a personal characteristic but also a complex regulatory system that supports attentional focus, control of impulsive reactions, stress resilience, and motivational stability in situations requiring urgent decisions. The developed logical-theoretical model demonstrated that the influence of emotional intelligence is realised through the combination of three interrelated components, namely emotional regulation, cognitive optimisation, and behavioural adaptation, which together form the capacity to act in a balanced and effective manner under time pressure. The results of the comparison across professional fields (medicine, business, sport, security) indicated that as the level of risk, responsibility, and decision-making speed increases, so does the importance of an individual's ability to regulate their emotional state.

Thus, emotional intelligence can be regarded as an important factor in improving the effectiveness of decision-making under time constraints, which determines the

strategic significance of its development for representatives of high-tempo professions. Prospects for further research include a more in-depth study of the influence of individual components of emotional intelligence on the accuracy and speed of decisions under different types of load, empirical testing of the proposed model in professional groups, and the development of digital tools for assessing emotional regulation in real time.

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## Емоційний інтелект та його вплив на ефективність прийняття рішень в умовах часових обмежень

**Анотація.** Метою роботи було визначення закономірностей впливу рівня розвитку емоційного інтелекту на якість і швидкість прийняття рішень у ситуаціях часових обмежень. Для досягнення поставленої мети було використано методи системного аналізу, узагальнення наукових підходів до вивчення емоційного інтелекту, логіко-теоретичне моделювання процесу прийняття рішень в умовах часових обмежень та елементи кількісного аналізу для структуризації отриманих результатів. Результати дослідження показали, що здатність усвідомлювати власні емоції та керувати ними підвищує точність вибору рішень у стислих часових проміжках. Аналіз наукових праць також довів, що емоційний інтелект відіграє важливу роль у підтриманні стабільності когнітивних процесів в умовах посиленого інформаційного й часового тиску. З'ясовано, що низький рівень емоційного інтелекту асоціюється з підвищеною імпульсивністю, когнітивним перевантаженням, зниженням точності оцінки ризиків і труднощами в прийнятті структурованих рішень. Аналіз показав, що розвиток емоційної стійкості та здатності до саморегуляції сприяє більш ефективному прогнозуванню можливих наслідків альтернативних дій, оптимальному розподілу ресурсів уваги, а також зменшенню впливу стресу й перевантаження на якість прийнятих рішень. Крім того, інтеграція когнітивних і емоційних компонентів емоційного інтелекту забезпечує адаптивність у складних і динамічних умовах, підвищуючи точність та швидкість вибору навіть у режимі обмеженого часу. Такий комплексний підхід дозволив розглянути емоційний інтелект як багаторівневий регуляторний механізм, що формує стійку основу для прийняття ефективних рішень у різних сферах професійної діяльності. Практична цінність роботи полягає в можливості застосування отриманих результатів для вдосконалення тренінгових програм розвитку емоційної компетентності, підготовки фахівців до роботи в умовах стресових навантажень, а також оптимізації процесів прийняття рішень у сферах освіти, управління, медицини, підприємництва та інших діяльнісних контекстах, у яких часові обмеження є постійним чинником

**Ключові слова:** когнітивна стабільність; саморегуляція емоцій; точність рішень; стресове навантаження; адаптивні стратегії; прийняття рішень

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**Scientific and methodological foundations  
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**Abstract.** The increasing number of individuals affected by military actions in Ukraine has intensified the need for scientifically grounded digital tools in psychological rehabilitation. The rapid development of immersive technologies necessitates the methodological systematisation of their application in rehabilitation psychology. The aim of the study was to substantiate and develop a comprehensive methodology for the application of virtual reality (VR) technologies in rehabilitation psychology, including the systematisation of therapeutic scenarios, the design of an intervention model, and the creation of an algorithm for scenario selection. The research methodology was based on an interdisciplinary theoretical analysis integrating cognitive-behavioural therapy, trauma-focused psychotherapy, neuropsychology, and immersive digital technologies. Methods of analysis, synthesis, structural-functional modelling, and systematisation were applied to construct a three-stage intervention model and to design standardised practical protocols. It was established that immersive environments allow controlled exposure to traumatic stimuli while maintaining psychological safety and therapeutic flexibility. A functional classification of twenty therapeutic scenarios was developed according to their roles in exposure, stabilisation, integration, mindfulness training, and cognitive restoration. A three-stage model of interventions (exposure-stabilisation-integration) was substantiated, ensuring sequential therapeutic influence and minimising the risk of retraumatisation. A step-by-step algorithm for selecting optimal scenarios was designed based on the client’s psycho-emotional state, therapeutic goals, and identified triggers. Standardised session protocols were structured, including preparatory, main, and integrative phases with

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defined duration parameters and safety criteria. The practical value of the results lies in their applicability for rehabilitation psychologists, clinical practitioners, and higher education institutions training specialists in psychological rehabilitation, particularly in work with veterans, internally displaced persons, and other trauma-affected populations

**Keywords:** virtual reality; trauma; mindfulness; exposure therapy; methodological protocols

## INTRODUCTION

The large-scale psychological consequences of military actions in Ukraine have significantly intensified the demand for structured and evidence-based approaches to psychological rehabilitation. Veterans, internally displaced persons, and civilians exposed to traumatic events require specialised interventions that combine clinical effectiveness with safety, controllability, and adaptability to individual psycho-emotional states. The complexity and scale of trauma-related conditions necessitate scalable and standardised therapeutic tools capable of ensuring both reproducibility and individualised regulation of emotional intensity. Traditional trauma-focused interventions, although empirically validated, present several limitations. They often rely on imaginal exposure or in vivo conditions that may lack sufficient controllability, reproducibility, and graded stimulus modulation. In contexts of severe trauma, these limitations may reduce therapeutic precision and increase the risk of destabilisation. In this regard, virtual reality (VR) technologies offer new possibilities for immersive, controlled, and adjustable therapeutic environments.

Systematic reviews and meta-analyses confirm the clinical effectiveness of VR-based exposure therapy. D. Schröder *et al.* (2023), synthesising randomised controlled trials, demonstrated statistically significant reductions in anxiety symptoms following VR interventions compared to control conditions. Y. Tan *et al.* (2025) further confirmed the effectiveness of VR exposure therapy for social anxiety disorder through meta-analysis and meta-regression, identifying variability in outcomes depending on protocol structure and therapist involvement. These findings not only support the therapeutic potential of VR exposure but also highlight the importance of structured implementation. In the context of post-traumatic stress disorder, L. Eshuis *et al.* (2021) reported that immersive VR exposure therapy is more effective than waitlist conditions and demonstrates outcomes comparable to traditional psychotherapeutic approaches. However, the authors emphasised heterogeneity in intervention protocols and methodological limitations within existing studies. Similarly, L. Dellazizzo *et al.* (2020), in a meta-review of meta-analyses, concluded that VR-based therapies show promising results across psychiatric conditions while underlining the need for greater methodological consistency and standardisation.

Beyond exposure-based interventions, VR applications have been explored for emotional regulation and stress reduction. W. Veling *et al.* (2021), in a randomised crossover trial, demonstrated significant short-term reductions in stress and anxiety levels using immersive relaxation environments. N. Baghaei *et al.* (2021), in a scoping

review, identified diverse formats of VR interventions for depression and anxiety and emphasised the absence of unified methodological frameworks. J. Planert *et al.* (2025), through qualitative thematic analysis, highlighted the importance of embedding VR interventions within structured therapeutic pathways and ensuring supervised professional implementation. In previous publications, the authors of the present study examined the integration of VR technologies into the national system of psychological rehabilitation and professional training of specialists in Ukraine. Those studies focused on educational and institutional aspects, emphasising the innovative and scalable potential of immersive technologies in wartime and post-war contexts. These findings are consistent with the results of recent Ukrainian research. In particular, O. Chaban *et al.* (2024) developed a virtual reality exposure therapy protocol for the treatment of post-traumatic stress disorder in military veterans, demonstrating the effectiveness of immersive environments for controlled exposure and cross-cultural adaptation of therapeutic approaches in Ukraine. In addition, M. Kolotilov *et al.* (2025), in a narrative review of post-traumatic stress disorder, highlighted the growing role of cognitive-behavioural and technology-assisted approaches in trauma treatment, emphasising the need for structured and clinically grounded intervention models.

However, despite these contributions, existing studies did not develop a comprehensive methodological framework for the clinical application of VR technologies, nor did they formalise functional classification principles, decision-making algorithms, or safety-oriented implementation protocols. Despite the growing body of evidence supporting VR effectiveness, several critical gaps remain. First, there is insufficient systematisation of VR scenarios according to functional therapeutic groups aligned with specific psycho-emotional states and intervention goals. Second, most studies concentrate on outcome effectiveness rather than providing structured clinical decision-making algorithms for practical application. Third, limited attention has been paid to integrating exposure, stabilisation, and integration phases within a unified methodological framework. Fourth, the issue of structured professional training and competency requirements for specialists implementing VR-based rehabilitation remains underexplored. Addressing these gaps is particularly important in the Ukrainian context, where the scale of trauma demands safe, scalable, and standardised rehabilitation solutions. The absence of clearly defined methodological protocols may hinder effective implementation, limit reproducibility, and increase variability in therapeutic outcomes. Therefore, the aim of

this study was to substantiate and develop a comprehensive methodology for the application of VR practices in rehabilitation psychology. The study seeks to classify VR scenarios into functional therapeutic groups, develop a structured algorithm for scenario selection based on psycho-emotional assessment, and formulate methodological protocols ensuring safety, consistency, and professional applicability.

## MATERIALS AND METHODS

The study was conducted within an interdisciplinary framework integrating cognitive-behavioral therapy, trauma-focused psychotherapy, neuropsychology, and immersive digital technologies. The research design was theoretical and methodological in nature and did not involve empirical data collection or participation of human subjects. The study aimed at developing a structured model for applying virtual reality technologies in rehabilitation psychology. A systematic analytical review of contemporary scientific literature was performed to ensure conceptual validity. The search was conducted in the databases Scopus, Web of Science, PubMed, and Google Scholar, with emphasis on publications from 2020-2025 due to the rapid evolution of immersive technologies. Peer-reviewed studies addressing virtual reality applications in trauma therapy, anxiety disorders, neuropsychological rehabilitation, and digital psychotherapeutic interventions were analysed. Priority was given to works presenting clearly described methodologies, empirical evidence, or theoretically grounded models relevant to the development of structured therapeutic protocols. Publications lacking methodological transparency or not directly related to therapeutic applications were excluded. This approach ensured scientific rigor, relevance, and a clear distinction between the theoretical stage of the research and potential future empirical validation.

The method of theoretical synthesis was applied to integrate exposure-based principles of cognitive-behavioural therapy, third-wave approaches (including mindfulness-oriented interventions), and neuropsychological concepts of emotional regulation and neuroplasticity. This synthesis enabled identification of mechanisms underlying immersive interventions, including habituation, extinction learning, attentional regulation, and adaptive memory reconsolidation. Structural-functional modelling was used to construct the three-stage intervention model: exposure, stabilisation, and integration. The exposure stage involves controlled activation of trauma-related emotional responses under monitored conditions. The stabilisation stage facilitates autonomic regulation and grounding through parasympathetic activation. The integration stage supports cognitive restructuring and consolidation of adaptive coping strategies. The sequential structure reflects psychophysiological adaptation processes and ensures therapeutic safety. Functional systematisation was applied to classify twenty therapeutic scenarios integrated into the Meta Quest 2 Pro virtual reality headset. The classification was based on primary therapeutic objective, level of sensory intensity, modality of stimulus presentation, cognitive

demand and potential psychological risks. This classification ensured correspondence between technological characteristics and therapeutic goals.

To operationalise practical application, descriptive and algorithmic modelling methods were used to design a structured decision-making algorithm for scenario selection. The algorithm was based on a sequential assessment of the client's psycho-emotional state, determination of the therapeutic objective, evaluation of contraindications and risk factors, and selection of an appropriate scenario in accordance with the functional classification. Duration parameters were determined in accordance with trauma-therapy principles and psychophysiological activation-recovery cycles. The preparatory phase (5-7 minutes) provides grounding and readiness assessment, exposure (3-12 minutes) ensures sufficient activation without overload, stabilisation (5-10 minutes) supports autonomic regulation, and integration (10-18 minutes) consolidates adaptive learning. These intervals correspond to mechanisms of emotional activation and recovery.

The proposed model is primarily theoretical and methodological in nature and requires empirical validation through controlled experimental designs. As part of this initiative, the Kyiv Institute of Business and Technology the NGO Stryzhen are currently conducting pilot testing of VR practices within the educational program Rehabilitation Psychology. At this stage, the use of VR technologies is exploratory and aimed at assessing their applicability, safety, and effectiveness in both educational and rehabilitation contexts. The pilot phase involves the integration of VR scenarios into the training of master's students, with a focus on developing practical skills in the use of immersive technologies for supporting individuals experiencing post-traumatic stress, anxiety disorders, and psycho-emotional exhaustion. The testing process includes systematic monitoring and evaluation of the effectiveness of VR practices, including the analysis of changes in psycho-emotional state, levels of engagement, and the development of professional competencies. In cases where participants are involved in the pilot implementation, ethical principles (The Belmont report..., 1979) are strictly observed, including informed consent, voluntary participation, data confidentiality, and the right to withdraw at any stage, in accordance with generally accepted standards for psychological research.

## RESULTS

### Theoretical foundations and key VR practices in psychological rehabilitation

The conceptual foundation for the use of virtual reality technologies in psychological rehabilitation lies in the fundamental principles of cognitive-behavioural therapy. Exposure therapy, developed by J. Wolpe (1958), is based on the principle of systematic desensitisation, according to which gradual and controlled confrontation with a feared object in safe conditions leads to a reduction in the anxiety response. The VR environment is ideally suited for

implementing this principle, as it allows for the creation of realistic but fully controlled conditions of exposure, stabilisation, and integration. An additional theoretical basis comes from the third wave of cognitive-behavioural therapy, in particular mindfulness practices and Acceptance and Commitment Therapy. The concept of mindfulness, systematised by J. Kabat-Zinn (1994), emphasised the importance of cultivating skills of non-judgmental observation of one's own thoughts and emotions. Virtual reality creates unique opportunities for training these skills by providing a high level of immersion and sustained attentional focus. The neurophysiological justification for the effectiveness

of VR neuro-trainers is based on an understanding of the mechanisms involved in the formation and processing of traumatic memories. Virtual environments activate the same brain structures as real stimuli but in controlled conditions, which allows safe engagement with traumatic material and the development of new, adaptive associations. Modern approaches to psychological rehabilitation increasingly integrate VR technologies, which make it possible to model controlled yet safe environments for therapeutic work. In this context, five key groups of VR practices can be distinguished, each serving specific functions and addressing different stages of mental health recovery (Table 1).

**Table 1.** Main VR-practices in rehabilitation psychology

Practice	Main Goal	Application Area	Key Advantages
Exposure	Reduction of fear and anxiety through controlled exposure	PTSD <sup>1</sup> , phobias, social anxiety, OCD <sup>2</sup>	Realism, controllability, safety, motivation
Stabilisation	Formation of a sense of safety and self-regulation	Before exposure; in states of anxiety or dissociation	Grounding, reduction of hyperarousal, prevention of retraumatisation
Integrative	Incorporating traumatic experience into personal life history	Trauma therapy, work with veterans, psychotherapy of addictions	Post-traumatic growth, new identity, resilience
Mindfulness	Development of mindful presence "here and now"	Trauma, depression, anxiety disorders, chronic pain	Stress reduction, emotion regulation, tolerance to distress
Neuro-trainers	Restoration of cognitive functions through training	Neurorehabilitation; psychological rehabilitation of veterans, ADHD <sup>3</sup> , elderly people	Neuroplasticity, individualisation, objectivity, integration with biofeedback systems

**Note:** <sup>1</sup>PTSD – post-traumatic stress disorder, <sup>2</sup>OCD – obsessive-compulsive disorder, <sup>3</sup>ADHD – attention deficit hyperactivity disorder

**Source:** developed by the authors based on Y. Kotukh *et al.* (2025a; 2025b) and B. Wiederhold & M. Wiederhold (2025)

Exposure practices are applied to recreate traumatic or anxiety-inducing situations in a virtual space. Through the gradual intensification of exposure, clients learn to regulate their emotional responses and reduce fear levels, particularly when working with PTSD, phobias, or social anxiety. VR technology enables complete environmental control and minimises the risk of retraumatisation. Stabilisation practices in VR provide a sense of safety and the development of self-regulation skills prior to deeper exposure work. Virtual environments are used for interactive breathing and body-based exercises, grounding techniques, and resource-building imagery, which are especially important for preventing dissociation or hyperarousal. Integrative practices in VR aim to incorporate traumatic experiences into an individual's life narrative and restore the integrity of personal identity. The use of group VR environments and interactive storylines facilitates the search for new meanings, existential orientation, and post-traumatic growth. Mindfulness practices in virtual spaces focus on training present-moment awareness. They help restore the ability to observe one's own thoughts and emotions without judgment, reduce stress and anxiety levels, and increase tolerance to distress.

The use of VR interfaces enhances the effect due to multisensory stimulation. Neuro-trainers, integrated into VR headsets, support cognitive function training based on

the principle of neuroplasticity. Such practices are applied in rehabilitation after strokes and traumatic brain injuries, in work with veterans and children with attention deficit hyperactivity disorder, as well as in preventing cognitive decline in older adults. VR neuro-trainers combine a high level of individualisation, objective outcome measurement, and the possibility of integration with biofeedback systems. The key advantages of the VR approach are the ability to precisely dose the intensity of therapeutic influence, ensure complete client safety, create standardised conditions of intervention while maintaining the possibility of individualisation, as well as a high level of client engagement and motivation in the therapeutic process.

### Three-stage model of VR interventions

Based on the analysis of modern approaches to trauma therapy and the specifics of VR technologies, a three-stage model of therapeutic interventions has been developed, ensuring the sequence and safety of the therapeutic process. The first stage – exposure – involves controlled immersion of the client into a virtual environment containing elements capable of evoking a moderate level of anxiety or discomfort. The goal of this stage is the gradual reduction of sensitivity to trigger stimuli through the mechanism of habituation. An important principle is the dosing of influence – the intensity of stimulation should be sufficient to

activate an emotional response, but not excessive so as not to lead to retraumatisation. The second stage – stabilisation – is aimed at restoring emotional balance and reducing physiological arousal after exposure. At this stage, calming VR scenarios are used, promoting activation of the parasympathetic nervous system and the formation of a sense of safety and control. The stabilisation stage is critically important for preventing the negative consequences of exposure and consolidating positive therapeutic experience. The third stage – integration – ensures the consolidation of the experience gained during the session and the development of skills for independent application of acquired self-regulation techniques. At this stage, the client not only restores emotional balance but also becomes aware of their own resources and abilities to cope with difficult situations in the future. The sequence of stages reflects the natural processes of adaptation of the nervous system to stressful influences and ensures optimal conditions for the formation of new, more adaptive reactions to traumatic stimuli.

Successful practical application of such a model requires organisational support and an institutional environment capable of ensuring its implementation in a broader social context. Therefore, the next step is the implementation of the developed model into practical activities, made possible through cooperation with the NGO Stryzhen. The participation of this organization in a grant program created opportunities for the testing of VR technologies in work with veterans, internally displaced persons, and other categories of affected individuals. Within the framework of a memorandum of cooperation with the Kyiv Institute of Business and Technology, it is planned to implement the task of scientific substantiation and practical integration of VR solutions into the field of rehabilitation psychology, covering both the educational process and clinical practice. In the Meta Quest 2 Pro VR headset, specialised therapeutic scenarios are integrated, developed with the needs of rehabilitation psychology in mind. These scenarios are systematised according to the principle of correspondence with the stages of the three-stage model of interventions and specific therapeutic tasks. The protocol of a VR session includes three main stages, each with specific tasks and methodological features. The preparatory stage, lasting five to seven minutes, involves a comprehensive assessment of the client's readiness for VR intervention. The client's psycho-emotional state is assessed using an anxiety scale from zero to ten points, as well as by observing non-verbal signs of tension. Critical is the identification of individual triggers that may be activated during the VR session. These triggers may be visual (open spaces, bright colours), auditory (loud sounds, specific melodies), or thematic (military symbols, crowds of people). A mandatory element of preparation is the establishment of a stop-signal and a detailed explanation of the possibility of stopping the session at any time.

The main stage, lasting fifteen to twenty-five minutes, implements the three-stage model of intervention. The session begins with an exposure scenario, which allows assessment of the client's reactions and, if necessary,

adjustment of the intensity of influence. The transition to the stabilisation stage is based on the observation of the client's physiological and behavioural reactions. Completion with an integration scenario ensures the consolidation of positive experience and the formation of a resourceful state. The psychologist's support during the main stage includes providing short instructions that help the client focus on therapeutic tasks, continuous monitoring of non-verbal reactions, and readiness for immediate intervention in case of signs of distress. It is important to maintain a balance between supporting the client and preserving their autonomy in the virtual environment. The final stage, lasting five to ten minutes, ensures a smooth return of the client to reality and the integration of the experience gained. The gradual removal of the VR headset is accompanied by orienting the client in space and time. Reflection of the experience includes discussing emotional reactions, useful insights, and strategies that helped overcome difficulties. A repeated assessment of anxiety makes it possible to objectively evaluate the effectiveness of the session.

#### **Algorithm for selecting a VR scenario**

The selection of a virtual reality scenario within the developed methodology is based on a structured assessment of the client's psycho-emotional state and the therapeutic objective of the session. The algorithm was designed as a methodological tool to ensure clinical safety, consistency, and alignment between intervention intensity and client readiness. The first stage of the algorithm involves a comprehensive assessment of the client's baseline condition. Anxiety level is evaluated using a subjective scale (0-10), complemented by qualitative analysis of behavioural manifestations and individual response patterns. Specific triggers are identified through structured clinical interviewing and observation. The client's physical state, including fatigue level and general well-being, is also considered, as these factors influence the selection and intensity of immersive stimulation. The second stage includes defining the primary therapeutic objective of the session. An exposure-oriented objective is determined when controlled activation of trigger stimuli is clinically appropriate and the client demonstrates relative emotional stability. A stabilisation objective is prioritised when elevated emotional arousal or physiological tension is observed. An integration objective is defined for clients who have developed basic self-regulation skills and are prepared to consolidate adaptive coping strategies. The third stage consists of selecting the scenario according to the established objective and the functional classification criteria. At this stage, sensory intensity, cognitive load, and potential risk factors are evaluated. The implementation phase includes continuous monitoring of behavioural and physiological indicators, allowing dynamic adjustment of stimulation parameters. The final stage ensures structured completion of the session through resource-oriented scenarios and reflective discussion of the experience. This algorithm constitutes a component of the methodological framework and is summarised in Table 2.

**Table 2.** Correspondence of VR-scenarios to stages of work

Stage of work	Goal	Recommended practices	Duration	Cautions
Exposure	Controlled immersion	Metaphorical images for working with emotional overload; grounding techniques via natural landscapes	3-5 min	Open spaces, fog
Exposure peak	Deepening contact with the stimulus	Slow movements with focused attention; complex sensory techniques	7-12 min	Sounds, complexity of instructions
Transition to stabilisation	Reduction of intensity	Underwater environments with smooth movements; interactive elements	5-8 min	Bright colours
Stabilisation	Restoration of control	Natural landscapes with selective attention; combined breathing techniques	5-10 min	Winter scenery
Integration	Consolidation of experience	Cyclical metaphors; interactive trainers for action algorithms	10-18 min	Demand on cognitive resources

**Source:** developed by the authors based on W. Veling *et al.* (2021), L. Eshuis *et al.* (2021), D. Schröder *et al.* (2023) and Y. Tan *et al.* (2025)

The structure presented in Table 2 reflects a sequenced therapeutic logic that integrates exposure, stabilisation, and integration as interconnected stages of intervention. The progression from controlled immersion to peak exposure, followed by reduction of intensity and restoration of self-regulation, corresponds to psychophysiological mechanisms of emotional activation and recovery. The differentiation of goals, recommended practices, duration parameters, and precautionary factors is intended to ensure alignment between the client's current psycho-emotional state and the intensity of immersive stimulation. The specified duration intervals are based on safety-oriented exposure principles and the need to prevent overstimulation, while allowing sufficient time for emotional processing and consolidation. Overall, the table operationalises the methodological framework by translating theoretical principles into structured practical guidance for rehabilitation psychology.

Effective implementation of virtual reality technologies in rehabilitation psychology requires structured professional preparation and clearly defined organisational conditions. Professional training should integrate theoretical knowledge, supervised practical experience, and personal immersion in VR environments as interconnected components of competency development. Theoretical preparation encompasses understanding the principles of exposure-based interventions, mechanisms of stress reactivity and emotional regulation, as well as neurophysiological responses to immersive stimuli and potential adverse effects such as dissociation, cybersickness, or excessive arousal. Practical training is based on supervised sessions with a gradual increase in scenario complexity, enabling specialists to develop the ability to assess the client's psycho-emotional state before and during immersion, identify early signs of distress or overstimulation, adjust sensory intensity in real time, and apply grounding or stabilisation techniques when necessary, including safe termination of exposure if required. Personal immersion in VR environments plays a critical role in developing professional competence, as it allows specialists to experience sensory load, recognise potential emotional triggers and perceptual distortions, and better anticipate client responses, thereby improving the timing and accuracy of therapeutic interventions.

Organisational conditions also significantly influence the effectiveness of VR-based rehabilitation. The technical environment should ensure stable hardware performance, properly calibrated equipment, hygienic safety, and uninterrupted access to communication tools. The physical space must be designed to provide sufficient freedom of movement, eliminate potential hazards, and maintain appropriate lighting, sound insulation, and ventilation conditions. Prior to each session, structured screening procedures are required to identify contraindications and potential risks. Absolute contraindications include epilepsy with seizure risk, acute psychotic states, and severe cognitive disorganisation, while relative contraindications may involve reduced concentration, pronounced psychomotor retardation, or technology-related phobias. Screening should also account for vestibular sensitivity and susceptibility to cybersickness. Ethical compliance is ensured through a clearly defined informed consent process, which includes explanation of the immersive nature of VR exposure, possible psychological and physiological reactions, the participant's right to discontinue the session at any time, procedures for managing adverse reactions, and conditions for data processing and confidentiality. Confidentiality requirements extend to behavioural responses recorded within the VR environment, session logs, and any physiological monitoring data. Data storage must comply with general clinical confidentiality standards and digital data protection regulations. Thus, effective VR implementation in rehabilitation psychology depends not only on technological availability but on structured training, therapist competence, controlled environmental conditions, and clearly defined ethical safeguards.

## DISCUSSION

The findings of the present study extend the existing body of empirical and theoretical research on virtual reality in psychotherapy by proposing a structured, safety-oriented, and operationalised methodological framework that integrates exposure, stabilisation, and integration within a unified model. Unlike many previous studies that primarily focus on treatment outcomes, the present research emphasises procedural standardisation, clinical decision-making,

and scenario classification, thereby addressing key methodological gaps identified in contemporary literature. The proposed approach is consistent with empirical evidence demonstrating the effectiveness of VR-based exposure therapy for anxiety and trauma-related disorders. A meta-analysis of randomised controlled trials conducted by E. Carl *et al.* (2019) confirmed that VR exposure therapy produces significant reductions in anxiety symptoms and shows comparable effectiveness to traditional in vivo exposure. Similarly, D. Schröder *et al.* (2023) and Y. Tan *et al.* (2025) provide high-level evidence supporting VR interventions, particularly emphasising their capacity to deliver controlled and reproducible exposure. These findings align with the exposure component of the three-stage model developed in the present study. However, while prior research validates effectiveness, it often lacks structured protocols for tailoring intervention intensity and sequencing therapeutic stages, which are explicitly addressed in the proposed algorithm.

In the context of post-traumatic stress disorder, L. Es-huis *et al.* (2021) demonstrated that immersive VR exposure therapy is more effective than waitlist conditions and comparable to conventional psychotherapy. At the same time, J. Maples-Keller *et al.* (2017) emphasised the importance of controlled environments and therapist-guided exposure in ensuring both safety and therapeutic effectiveness. These findings are directly reflected in the current model, which integrates continuous monitoring and adaptive intensity regulation as core elements of intervention design. The theoretical foundations of the proposed methodology are also supported by broader conceptual frameworks in psychotherapy. In particular, the integration of mindfulness-based and acceptance-oriented approaches corresponds to the principles of Acceptance and Commitment Therapy, which emphasises psychological flexibility, emotional regulation, and experiential processing (Hayes *et al.*, 2006). The inclusion of stabilisation and integration phases in the present model expands traditional exposure paradigms by incorporating mechanisms of emotional recovery and cognitive restructuring, thereby addressing limitations of purely exposure-based approaches. Furthermore, the conceptualisation of VR as a transformative therapeutic medium is consistent with the work of G. Riva *et al.* (2016), who highlighted the potential of immersive technologies to reshape experiential processing and facilitate psychological change. The ability of VR to simulate controlled yet realistic environments enables not only exposure but also the reconstruction of meaning and identity, which is particularly relevant in trauma rehabilitation.

Empirical support for the integration of multiple therapeutic functions within VR systems is provided by I.-C. Stanica *et al.* (2024), who demonstrated that multi-therapy VR interventions produce significant improvements in both psychological and physiological outcomes. This supports the multidimensional structure of the present model, which combines exposure, stabilisation, and integration rather than treating them as isolated

components. In contrast to such integrated approaches, many earlier studies focus on single-function interventions, thereby limiting their applicability in complex clinical contexts. At the same time, several studies emphasised the lack of methodological consistency in VR-based interventions. L. Dellazizzo *et al.* (2020) and N. Baghaei *et al.* (2021) highlighted heterogeneity in protocols, outcome measures, and implementation strategies, which complicates comparison across studies and reduces reproducibility. The present research directly addresses this limitation by proposing a structured classification of therapeutic scenarios and a decision-making algorithm that standardises intervention selection based on psycho-emotional state and therapeutic goals.

The importance of structured implementation is further supported by qualitative findings reported by J. Planert *et al.* (2025), which underline the need for coherent therapeutic pathways and professional supervision in VR-based treatment. B. Wiederhold & M. Wiederhold (2025), in an expert review article, discussed the combination of virtual reality therapy with physiological monitoring to provide objective treatment metrics in post-traumatic stress disorder. Although the publication format is conceptual rather than experimental, it highlights the potential value of incorporating physiological indicators into VR-based treatment frameworks. This perspective supports the inclusion of monitoring elements within the safety-oriented algorithm developed in the present methodology. Y. Li *et al.* (2026) presented a protocol for a systematic review examining the effectiveness of self-guided virtual reality exposure therapy for social anxiety disorder. As a protocol, it does not report outcome data but indicates emerging scientific interest in autonomous VR applications. Similarly, W. Graham *et al.* (2025), in a systematic review published as a preprint, analysed self-guided VR therapy for anxiety and noted both accessibility advantages and concerns regarding insufficient clinical supervision. Compared to these autonomous models, the present approach retains therapist guidance while integrating algorithmic decision-making, thereby balancing personalisation with clinical oversight.

In addition to international research, the findings of this study are consistent with emerging Ukrainian scholarship on the role of VR in psychological rehabilitation. Y. Glybchenko (2023) conceptualises VR technologies as a PeaceTech instrument capable of supporting psychological recovery and resilience in wartime conditions, emphasising their scalability and societal relevance. Moreover, previous studies by Y. Kotukh *et al.* (2025a; 2025b) demonstrate the feasibility of integrating VR into both educational and rehabilitation systems in Ukraine, highlighting its potential for training specialists and supporting trauma-affected populations. However, these studies primarily focus on institutional and applied aspects, whereas the present research advances the field by providing a structured methodological framework for clinical implementation. The stabilisation phase proposed in the current study finds empirical support in the randomised crossover trial conducted

by W. Veling *et al.* (2021), which demonstrated that immersive virtual relaxation significantly reduces stress and anxiety levels in psychiatric populations. As this conclusion is derived from a randomised controlled design, it provides empirical justification for incorporating relaxation-based VR scenarios as a distinct therapeutic component rather than an auxiliary feature of exposure.

Overall, the proposed model differs from existing approaches in several key aspects. First, it introduces a functional classification of VR scenarios aligned with psycho-emotional states and therapeutic objectives, which is largely absent in prior studies. Second, it operationalises clinical decision-making through a step-by-step algorithm, addressing the lack of standardised implementation procedures. Third, it integrates exposure, stabilisation, and integration into a single coherent framework, thereby reflecting psychophysiological processes of activation and recovery. Finally, it incorporates safety-oriented mechanisms, including continuous monitoring and adaptive intensity regulation, which respond to concerns regarding retraumatisation risk.

## CONCLUSIONS

The developed scientific and methodological foundations for the step-by-step application of twenty VR scenarios in rehabilitation psychology create a theoretical and practical basis for the introduction of innovative technologies into the national system of psychological assistance. The three-stage model of interventions ensures systematic and safe therapeutic processes, and detailed protocols and algorithms provide specialists with concrete tools for practical work. Systematisation of VR scenarios by functional purpose makes it possible to select therapeutic interventions in a targeted way, depending on the client's current needs and stage of rehabilitation. The developed methodological recommendations take into account both technical and ethical

aspects of VR application, ensuring high standards of professional activity. The implementation of Meta Quest 2 Pro with integrated therapeutic scenarios into rehabilitation psychology practice has significant potential to improve the effectiveness of assistance to individuals with traumatic experiences. Controllability, safety, and a high level of client engagement make VR technologies a valuable addition to traditional methods of psychological rehabilitation. The presented methodological developments are the initial stage toward large-scale implementation of VR technologies in national psychological practice.

The proposed methodological framework has implications not only for clinical practice but also for the modernisation of professional training in rehabilitation psychology. Its implementation requires systematic integration of structured VR-based modules into university curricula, the development of competency-based standards for immersive interventions, supervised practice models, and regulatory guidelines to ensure safe, ethical, and effective professional application. Further development of this field requires empirical testing of the effectiveness of the proposed approaches, expansion of the VR toolkit, and systematic training of qualified specialists. Successful implementation of these tasks will contribute to a significant improvement in the quality of psychological rehabilitation and the creation of a modern, technologically equipped system of psychological assistance in Ukraine.

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## Науково-методологічні засади використання VR-практик у реабілітаційній психології

**Анотація.** Зростання кількості осіб, які постраждали внаслідок військових дій в Україні, актуалізувало потребу у науково обґрунтованих цифрових інструментах психологічної реабілітації. Стрімкий розвиток імерсивних технологій зумовлює необхідність методологічної систематизації їх застосування у реабілітаційній психології. Метою дослідження було обґрунтування та розроблення комплексної методології використання технологій віртуальної реальності (VR) у реабілітаційній психології, зокрема систематизації терапевтичних сценаріїв, проектування моделі втручання та створення алгоритму вибору сценаріїв. Методологія дослідження ґрунтувалася на міждисциплінарному теоретичному аналізі, що поєднує когнітивно-поведінкову терапію, травмофокусовану психотерапію, нейропсихологію та імерсивні цифрові технології. Для побудови трьохетапної моделі втручання та розроблення стандартизованих практичних протоколів застосовано методи аналізу, синтезу, структурно-функціонального моделювання та систематизації. Встановлено, що імерсивні середовища забезпечують контрольовану експозицію до травматичних стимулів із збереженням психологічної безпеки та терапевтичної гнучкості. Розроблено функціональну класифікацію двадцяти терапевтичних сценаріїв відповідно до їх ролі в експозиції, стабілізації, інтеграції, тренуванні усвідомленості та когнітивному відновленні. Обґрунтовано трьохетапну модель втручання (експозиція – стабілізація – інтеграція), що забезпечує послідовний терапевтичний вплив і мінімізує ризик ретравматизації. Запропоновано покроковий алгоритм вибору оптимальних сценаріїв з урахуванням психоемоційного стану клієнта, терапевтичних цілей і визначених тригерів. Структуровано стандартизовані протоколи сесій, що включають підготовчий, основний та інтеграційний етапи з визначеними параметрами тривалості та критеріями безпеки. Практична цінність результатів полягає у можливості їх застосування реабілітаційними психологами, клінічними практиками та закладами вищої освіти, які готують фахівців у сфері психологічної реабілітації, зокрема у роботі з ветеранами, внутрішньо переміщеними особами та іншими категоріями осіб, що зазнали травматичного впливу

**Ключові слова:** віртуальна реальність; травма; усвідомленість; експозиційна терапія; методологічні протоколи

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