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The Use of Interactive Teaching Methods in the Professional Military Training of Future Reserve Officers in Higher Education Institutions

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ABSTRACT

Purpose of the study: The article examines improving professional military training for future reserve officers in higher education through interactive teaching methods. It analyzes their use across courses, evaluates effectiveness from students' perspectives, and identifies organizational, content, and resource barriers. Particular attention is given to instructional design, emphasizing learner engagement, decision-making, feedback quality, and learning outcomes supported by digital simulations within contemporary technology-enhanced educational environments.

Methodology: The study employed regulatory document analysis, classroom observation, and an empirical survey conducted at the Department of Military Training of Ivan Chernyakhovsky National Defence University of Ukraine. The sample included 92 respondents, comprising 44 teachers and 48 students.

Main Findings: The results show that only 43% of classes applied interactive methods, while most relied on traditional lectures. Situational modelling (83%) and role-playing (71%) were most frequently used and rated highly effective by students. In contrast, multimedia simulations and self-management methods were least applied due to technical and methodological limitations. Key barriers included limited preparation time, restricted digital access, formalized assessment, and insufficient readiness. Findings reveal a gap between method frequency and learning impact, with simulation-based approaches most effective for developing flexible thinking, teamwork, cognitive load regulation, and situational adaptability.

Novelty/Originality of this study: The study provides a systematic analysis of interactive training practices in Ukrainian military education focused on reserve officer preparation. It contributes to understanding how interactive and simulation-supported methods can enhance instructional design and offers practical recommendations for course restructuring, methodological support, and institutional development.

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1. INTRODUCTION

2020 and 2025, military training systems in higher education institutions (HEIs) in Ukraine have undergone substantial transformation under the combined influence of armed conflict, regulatory reforms in the defence sector, accelerated digitalization of education, and the operational demands generated by mobilization policy. In this context, the role of reserve officers has expanded beyond traditional auxiliary functions, placing increased emphasis on adaptability, decision-making under uncertainty, and readiness to operate in both combat and rear-area environments. These conditions have intensified the urgency of revising instructional approaches in military education, particularly through the integration of interactive teaching methods that support practice-oriented and competence-based training models.

Contemporary pedagogical research consistently demonstrates that interactive and experiential learning formats enhance professional competence development by promoting active engagement, situational analysis, and reflective learning processes [1]. In military education, such approaches are especially relevant, as they correspond to the complexity and unpredictability of operational environments. The concept of the professional competence of a reserve officer is therefore understood as an integrative construct encompassing cognitive, operational, communicative, emotional-regulatory, and strategic-reflexive dimensions, all of which require instructional formats that go beyond traditional lecture-based delivery.

Within higher education more broadly, student-centered learning, problem-based learning, and experiential learning have become core pedagogical foundations for instructional design [2]. In military training, these principles are increasingly implemented through modelling, case-based instruction, teamwork, and decision-making in simulated operational contexts. The growing availability of digital simulation technologies, including systems such as VBS4, JCATS, and VR-Forces, has further expanded opportunities for technology-enhanced interactivity. Their pedagogical potential aligns with established frameworks of educational technology integration, notably the TPACK model and the SAMR framework, which emphasize the transformative role of digital tools in instructional design rather than their purely instrumental use [3], [4].

Despite this progress, a significant research gap remains. Existing studies predominantly examine interactive learning either in general higher education or in the training of active-duty military personnel, while the specific context of reserve officer preparation in HEIs remains underexplored, particularly with regard to the alignment between interactive teaching methods, digital simulation tools, and instructional design quality. Moreover, limited empirical attention has been paid to the discrepancy between the declared adoption of interactive methods and their actual pedagogical effectiveness, as well as to the organizational and technological barriers that constrain their systematic implementation.

The scientific novelty of this study lies in its systematic empirical analysis of real instructional practices in Ukrainian military education focused specifically on the training of future reserve officers. Unlike prior conceptual or normative analyses, the present research examines the frequency, perceived effectiveness, and instructional impact of interactive methods, with particular attention to simulation-based tools as elements of technology-enhanced instructional design. By integrating quantitative data from both instructors and students, the study provides evidence-based insights into how interactive learning formats influence engagement, decision-making dynamics, and feedback structures in military training.

The aim of the study is to examine the use of interactive teaching methods in the professional military training of future reserve officers in Ukrainian higher education institutions. The objectives of the research are to determine the extent to which interactive methods are applied in training courses; to assess their perceived effectiveness from the students' perspective; to identify organizational, methodological, and resource-related barriers to their implementation; and to analyse the role of digital simulation tools in enhancing instructional design and learning outcomes in reserve officer education.

2. THE COMPREHENSIVE THEORETICAL BASIS

In 2020–2024, the problem of integrating interactive methods into the professional military training of reserve officers has developed in several directions. Kosonen et al. [5], examined the motivation structure of cadets in reserve officer training and their perception of programme content, noting the limited integration of interactive components in the field phase of instruction and the predominance of frontal methods. Such findings also illustrate the absence of technology-enhanced instructional design principles, which, according to the SAMR model, could elevate interactive tasks beyond simple substitution. In contrast, Fullerton et al. [6], focused on a narrative analysis of the experience of US Marine Corps Reserve cadets, indicating the need for adaptive dialogic methods emphasizing leadership and real-time decision-making. These results correspond to the collaborative

practices described in computer-supported collaborative learning (CSCL), where interaction and problem-solving are essential mechanisms of learning.

Powell & Townley [7] investigated innovative approaches to teaching tactical subjects, highlighting the effectiveness of the case method and scenario-based training, particularly in preparing for non-standard threats. Scenario variation and immersion described in this study align with simulation-based learning theory and experiential learning models widely used in higher education. His approach contrasts with the position of Boyce et al. [8], which emphasizes extended reality in military training, noting that technological tools improve visualization but do not always ensure proper tactical interaction between students. This reflects a misalignment between technology and pedagogy, which in TPACK terms indicates insufficient integration of technological and pedagogical knowledge [9]-[11].

Researchers Yogaswara [12] examined the effectiveness of simulation games and role-playing, noting their contribution to critical thinking, communication, and emotional stability. These interactive activities represent classic examples of digital pedagogy, where learner engagement and active participation become central. The study shares common elements with McCarrick et al. [13], which conducted a systematic review of simulation-based military training and emphasized leadership as a core competence supported by interpersonal modelling. However, the review remained conceptual and lacked detailed didactic recommendations.

The study of Savchenko et al. [14] focused on the readiness of graduates for service, revealing a discrepancy between theoretical preparation and real operational challenges. In terms of instructional design, this gap suggests the insufficient application of technology-supported experiential learning cycles that could bridge classroom instruction with operational environments. Binsch et al. [15] considered virtual reality platforms in military-oriented training, examining criteria such as tactical relevance, immersion, and learning outcomes. These elements correspond to higher levels of the SAMR framework-modification and redefinition-where technology enables fundamentally new forms of learning tasks.

Researchers Fullerton et al. [16] analysed administrative constraints in integrating interactive elements into Junior ROTC programmes, highlighting regulatory barriers and weaknesses in evaluation criteria. These challenges illustrate the systemic obstacles to implementing TPACK-aligned educational strategies, where technological, pedagogical and content components must function cohesively. Haugegaard [17] examined targeted cultural scenario simulations for Danish officers, demonstrating how immersion enhances adaptability within multinational operations. The findings correlate with Harris et al. [18], which examined virtual reality in decision-making training and noted that immersive technologies strengthen dynamic responses but require supplementary methods for comprehensive competence development.

Researchers Jalowska & Prokopczyk [19] assessed the physical readiness of reserve forces using Polish standards, linking training directly to real combat loads. Meanwhile, Fraulini et al.[20] offered a meta-analysis of adaptive training interventions, emphasizing readiness indicators and institutional capacity. Kosonen et al.[21] explored flipped learning in the Finnish Army, showing that digital self-training tools increase responsibility but demand robust digital infrastructure. These findings correspond with Last et al. [22], who analysed international simulations in Arctic conditions, highlighting the importance of intercultural communication and strategy adaptation.

Taken together, the reviewed studies demonstrate that although the integration of interactive, scenario-based, and simulation-supported methods is actively explored, much of the literature remains centred on military-specific outcomes rather than broader educational technology perspectives. By interpreting the results through instructional design frameworks such as SAMR, TPACK, digital pedagogy, CSCL, and simulation-based learning theory, it becomes clear that many interactive practices described in [7], [9], [10], [12], [18] inherently align with technology-enhanced learning models used in higher education. Their emphasis on immersion, role distribution, and scenario variation corresponds to experiential and simulation-based learning cycles. At the same time, the infrastructural and institutional constraints discussed in [16], [21] highlight the need for more coherent technology–pedagogy alignment.

Thus, the analysed literature, although primarily military in origin, can be situated within established educational technology paradigms, demonstrating the relevance of interactive, simulation-based, and digitally mediated learning as essential components of modern instructional design.

3. RESEARCH METHOD

The study employed a three-stage research design to examine the effectiveness of interactive methods in the professional military training of future reserve officers in higher education institutions (HEIs). The research was conducted within the doctoral programme of the Academic Department for the Organization of Training and Certification of Academic and Teaching Staff at the Academic and Methodological Centre for the Organization of Scientific and Technical Activities of Ivan Chernyakhovsky National Defence University of Ukraine. The theoretical foundation was based on the Strategy for the Development of Higher Education of Ukraine for 2022–2032 [23], standards for training reservists in tactical, engineering, and logistics profiles [24], methodological

guidelines of the Ministry of Defence of Ukraine [21], and training practices of NATO member states [25]. The methodological framework was further informed by experiential learning, student-centred instruction, and technopedagogical integration through the TPACK and SAMR models.

The study was conducted from November 2024 to April 2025. The first stage (November–December 2024) involved analysis of national and international pedagogical literature and regulatory documents related to reserve officer training in blended learning formats [26]-[28]. Particular attention was given to the classification of interactive methods, conditions for their implementation, and alignment with professional training objectives. Educational models from NATO countries were examined [29], along with comparative analyses of practices in Poland, Denmark, Finland, Indonesia, and the United States [30]-[32]. This stage also analysed the pedagogical potential of digital simulation systems (VBS4, JCATS, and VR-Forces) as tools supporting interactivity, decision-making processes, and experiential modelling within technology-enhanced instructional design.

The second stage (January–February 2025) focused on content analysis of curricula and methodological support within the Department of Military Training at Ivan Chernyakhovsky National Defence University of Ukraine. Course programmes including Tactics, Organization of Combat Training, Commander's Activities, and Reserve Training were examined to assess alignment between learning outcomes, cognitive load distribution, and opportunities for digital augmentation through simulation technologies.

The third stage (March–April 2025) comprised an empirical study using semi-structured questionnaires administered to teachers and cadets, complemented by focused interviews with teaching staff. The instruments measured the frequency and perceived effectiveness of interactive methods, their influence on professional competencies, and barriers to implementation. Reliability was confirmed through expert validation, yielding a Cronbach's alpha of 0.84. Data triangulation was achieved through document analysis, expert observation, and survey and interview results.

The study applied theoretical analysis, content analysis, expert classroom observation, and survey methods. Statistical procedures included descriptive statistics (mean, median, mode, frequencies), Spearman's correlation coefficient (ρ) to assess relationships between frequency of use and perceived effectiveness, and the χ^2 test to determine statistical significance across profiles. All analyses were conducted using SPSS 26.0.

Digital simulation was conceptualised as an educational technology rather than solely a military tool. VBS4 supported collaborative situational modelling, JCATS enabled branching decision-making with adjustable variables, and VR-Forces facilitated immersive scenario visualisation. These platforms followed an interactive learning sequence comprising scenario familiarisation, decision modelling, peer interaction, and reflection through After Action Review, consistent with experiential learning cycles and SAMR-based instructional modification.

To demonstrate applied implementation, a training scenario entitled Evacuation of Personnel from an Area of Increased Fire Activity with Disrupted Radio Communication was simulated. Participants selected among three alternative courses of action based on evolving operational conditions, risk assessment, team communication, and decision-making within JCATS, followed by an After Action Review. This scenario illustrates how digital simulations function as pedagogical innovations that enhance engagement, distributed cognition, and controlled exposure to operational complexity.

The study involved 92 participants (44 instructors and 48 cadets) from six military HEIs across different regions of Ukraine, representing tactical, technical, and logistics profiles. A purposive, stratified sampling strategy was employed to ensure functional representation across professional domains. The study was pilot in nature with elements of longitudinal observation. Data were collected using Google Forms and paper-based questionnaires in regions with limited internet access. All instruments contained 23 items and supported quantitative and qualitative analysis using Excel, Datawrapper, and SPSS. All data were anonymised in accordance with GDPR (2023–2024), and participation was voluntary with informed consent approved by institutional authorities.

4. RESULTS AND DISCUSSION

The review of regulatory and methodological materials identified three main approaches to the classification of interactive methods in military training: structural (classification by the degree of tactical complexity and team participation), functional (correspondence to specific training goals and roles), and scenario simulation (orientation to real combat conditions). In the documents of the North Atlantic Alliance, the division into map-based games, decision-making simulations, staff coordination drills and field scenario-based learning was typical, with detailed instructions on procedures and assessment criteria. National regulatory materials, by contrast, presented only a list of forms without internal content-based classification. This inconsistency indicates a methodological gap in instructional design, where the absence of internal structuring limits the transition from traditional instruction to technology-enhanced learning models such as SAMR and TPACK.

Differences in understanding tactical training principles were also identified. NATO documents emphasize the flexibility of commanders' decisions, independence of group actions and decision-making under uncertainty, while Ukrainian standards prioritize compliance with combat-training tasks without specifying mechanisms for developing critical thinking or team interaction. As a result, the same method-for example, a situational game-took different forms across systems in terms of teacher roles, structure of tasks and feedback

formats. These discrepancies directly relate to experiential learning theory, where the depth of reflection and structured feedback determines whether learners transition from simple tactical reproduction to higher-order cognitive engagement.

A list of common factors for the effective implementation of interactive methods in military programmes was formed: adaptive scenarios, modifiable conditions, technical support (navigation maps, combat schemes, decision-making systems), instructor roles as moderators rather than controllers, and simulation environments with elements of unpredictability. These factors align with the principles of collaborative learning (CSCL), where distributed interaction, shared situational awareness and joint decision-making contribute to competence formation. The emphasis on modifiable scenarios also corresponds to experiential learning cycles, in which learners repeatedly test hypotheses, evaluate decisions and reflect on outcomes.

Digital simulators (VBS4, JCATS, VR-Forces) represent the clearest example of movement toward technology-enhanced instructional design, as they allow tasks to be redefined rather than merely substituted, corresponding to the redefinition level of the SAMR framework. Their use supports reflective practice through After Action Review and facilitates collective engagement, which is essential for military competencies. These platforms also function as EdTech tools that distribute cognitive load, allow safe experimentation with complex tactical variables, and activate deep learning mechanisms.

Table 1 presents the generalized characteristics of the main interactive methods recorded in the regulatory sources of the Ministry of Defence of Ukraine and NATO materials. The comparative analysis shows that methods linked to scenario variation and simulation demonstrate the strongest alignment with modern instructional design approaches, whereas methods lacking structured feedback or technological augmentation show weaker potential for developing higher-order skills. This supports the need for a conceptual model that integrates interactivity, simulation and reflective cycles into military curricula.

Table 1. Generalized characteristics of interactive methods according to the provisions of the Ministry of Defence and NATO standards (2020–2025)

Method	Description (Ministry of Defence of Ukraine)	Description (NATO)	Purpose of application	Assessment (author's analysis)
Situational modelling	Simulating combat or crisis conditions with fixed introductions to develop tactical thinking	Simulation-based training with an emphasis on situational adaptability and multi-agent modelling	Development of flexible thinking, adaptation to non-standard situations	Highly effective in developing adaptability; requires significant resources for realistic imitation
Command and staff exercises	Using standard combat scenarios to coordinate actions between units	Command Post Exercises (CPX) via CAX systems to assess team interaction	Formation of skills in department management and interaction	Strong coordination tool; limited development of individual skills
Role-play scenarios	Playing out typical service situations to train decision-making	Scenario-based role training with realistic role distribution	Development of role competencies and communication skills	Improves communication; depends on the preparedness of participants
Case studies	Analysis of real or hypothetical situations to develop algorithms of actions	Case-study learning as a form of after action review or critical mission analysis	Deepening analytical thinking and the ability to reflect	Promotes in-depth analysis; may be ineffective without proper moderation
Problem-oriented seminars	Discussion with prior study of a specific task or incident	Problem-based sessions as a debriefing platform with elements of critical thinking	In-depth understanding of complex problems and strategies for solving them	High potential for critical thinking; requires experienced facilitators
Digital simulators VBS4, JCATS, VR Forces	Not directly fixed in Ministry of Defence of Ukraine documents; used locally for visualization or CAX sessions	Virtual Battle Space (VBS4), Joint Conflict and Tactical Simulation (JCATS), VR-Forces – as components of CAX-structures	Integration into the basic phase of training, assessment of decision-making dynamics, simulation of complex conditions	Maximum integrated efficiency; requires technical support and instructor training

Source: created by the author based on [27], [29].

Table 1 contains comparative characteristics of interactive methods defined in the regulatory documents of the Ministry of Defence of Ukraine and NATO Reservist Training Standards. Both systems prioritise situational modelling, team exercises and role-playing scenarios, although NATO materials provide clearer procedural guidance and emphasise action under uncertainty, interchangeability of roles and evaluation based on simulation outcomes. Ukrainian standards, by contrast, focus on algorithmic execution of duties, which reflects a more instructional, less adaptive training model. The analysis showed that situational modelling and digital simulators demonstrate the highest integrated efficiency, while case methods and problem-oriented seminars best support analytical thinking, provided qualified facilitation is ensured. These patterns correspond to experiential learning, where flexible scenarios and structured reflection strengthen professional judgement, whereas rigid algorithm-based training limits adaptive decision-making. NATO standards include a separate methodological block on digital simulators (VBS4, JCATS, VR-Forces), used to model tactical complexity, stress conditions and decision alternatives. In instructional design terms, these platforms function as pedagogical tools that support collaborative learning (CSCL) and enable task transformation at the SAMR "modification–redefinition" levels. In Ukrainian materials, simulators appear only as auxiliary components within other methods. This indicates a gap between available technologies and their pedagogical integration, suggesting the need for clearer technopedagogical design and alignment with modern experiential and simulation-based learning models.

Figure 1 presents a comparison of interactive methods with the main goals of reserve officer training – flexible thinking, team interaction, and analytical reflection – based on expert tri-point assessment.

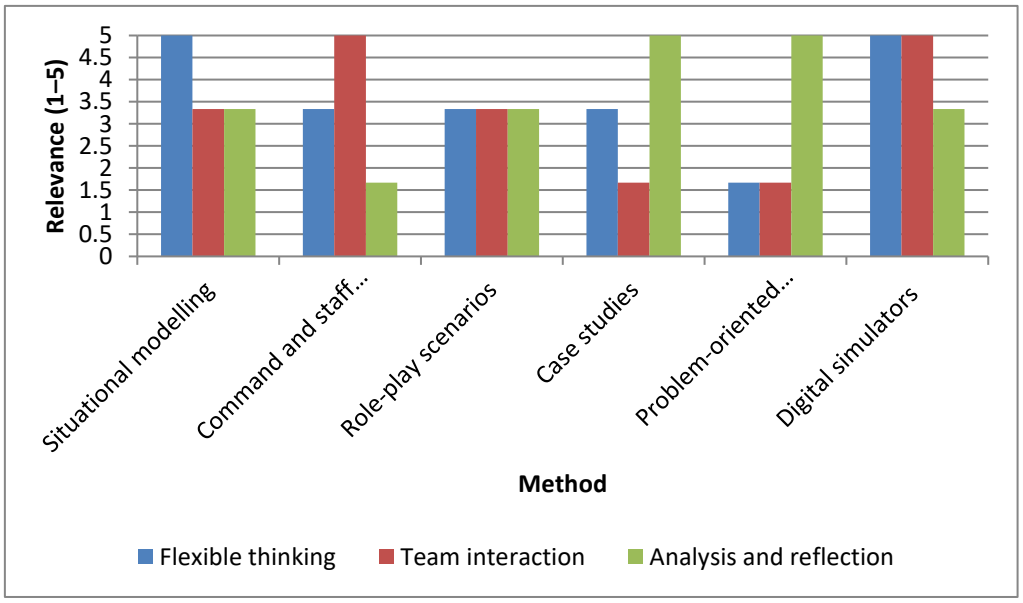

Figure 1. Relevance of interactive methods to key training objectives for reserve officers
Source: created by the authors based on their own research

Figure 1 demonstrates the generalized correspondence of interactive methods to the key educational goals of reserve officer training: the development of flexible thinking, team interaction skills and analytical-reflective abilities. The numerical values reflect the expert scale of relevance within a five-point system, based on regulatory analysis (Table 1), observations and focus group data. Digital simulators received the highest score for all criteria, confirming their integrated effectiveness. The case method and problem-oriented seminars were most relevant for analytical thinking, while situational modelling proved strongest for stimulating flexible tactical reasoning. These results align with experiential learning principles, where scenario variation and reflection cycles support deeper cognitive engagement, and with collaborative learning theory, which emphasises distributed decision-making in dynamic conditions**.** Analysis of the educational programmes of the Department of Military Training (Tactics, Reserve Training, Commanding Activities) showed that interactive methods are structurally embedded in the learning process. The dominant formats included situational modelling, command-and-staff training and role-distributed algorithmic exercises. Course content required students to analyse simulated combat tasks and correct tactical errors, which corresponds to problem-oriented instruction. The emphasis on changing environments and solution variability reflects the logic of technology-supported experiential tasks, where learners repeatedly test hypotheses and refine decision-making strategies.

Educational and methodological materials contained detailed command scenarios, simulation instructions, decision-making tables and task cards with branching alternatives. The analysis of VBS4, JCATS and VR-Forces confirmed their use in basic officer training phases for modelling complex tactical conditions, acting under stress and exploring alternative decisions. From an instructional design perspective, these simulators operate as digital learning environments that support the SAMR "modification–redefinition" levels by transforming traditional tasks into collaborative, data-rich and reflective activities. Observation of three classroom sessions demonstrated combined learning models in which frontal explanations alternated with simulation exercises and case studies. Students actively distributed functions, made joint decisions and corrected actions based on instructor feedback. Instructors generally followed a target-oriented session flow: introduction, group modelling, analysis and summarisation. However, differences in methodological flexibility were observed, indicating varying levels of technopedagogical competence. Those who adapted scenarios based on group dynamics more effectively activated collaborative learning mechanisms and reflective practice.

In general, methodological consistency was recorded in implementing content modelling oriented toward applied tactical skills. Figure 2 presents the typology of interactive methods and digital simulators in Ministry of Defence and NATO standards, enabling comparison between regulatory expectations and observed instructional practices. The alignment patterns highlight both strengths of current approaches and the need to expand technopedagogical integration to fully exploit the learning potential of digital simulations.

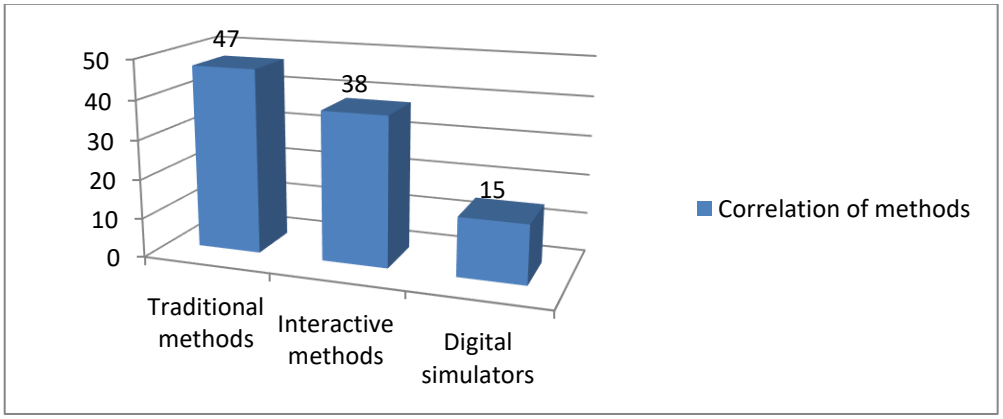

Figure 2. Correlation of learning methods based on observational results (2025)
Source: created by the author based on observations conducted during the research phase, taking into account [23], [27].

Figure 2 shows the updated ratio of traditional, interactive methods and digital simulators recorded during the observation of training sessions. Traditional methods (lectures, briefings, frontal explanations) accounted for 47%, remaining dominant in organizing the educational process. Interactive methods, including situational modelling, case analysis and team tasks, made up 38%, indicating active integration of modern didactic practices. Digital simulators (VBS4, JCATS, VR-Forces) represented 15% of use and appeared mainly in CAX sessions or local simulations. This distribution reflects a gradual transition toward blended learning, where traditional formats are supplemented by technology-enhanced environments aimed at strengthening visualization, adaptability and decision dynamics. Such a configuration corresponds to SAMR-based instructional modification and the early stages of technopedagogical integration.

The empirical assessment revealed stable patterns in the use of interactive methods during reserve officer training. Teachers most frequently employed situational modelling (83%), role-playing exercises (71%) and collective case analysis (68%). Less widespread were game simulations, multimedia platforms and self-managed training formats (below 45%). These preferences align with experiential learning, which prioritizes scenario-based tasks and collective reflection, and with CSCL principles, where team-based interaction becomes central to competence development.

Students' assessments demonstrated high correlation with teachers' responses: 78% of cadets indicated that interactive interaction supports tactical planning, and 74% noted improvements in adaptability to non-standard situations. The most effective methods, according to students, were group dynamics, situational analysis and structured debates, while 62% reported insufficient overall interactivity. This discrepancy suggests a gap between existing instructional practice and learners' need for deeper engagement, indicating the importance of reflective cycles and adaptive instructional design.

Focused interviews confirmed survey findings and clarified barriers: lack of time (88%), overloaded curricula (76%) and limited technical support (69%). Respondents also referred to insufficient standard scenarios and methodological materials, noting that formalized reporting often discourages experimentation with interactive

tools. These barriers reflect shortcomings in TPACK alignment, where technological, pedagogical and content components are not equally supported at the institutional level.

Adaptation practices were also documented: instructor-designed training based on combat experience, modified NATO group algorithms, and digital mock-ups instead of printed materials during tactical analysis. These cases illustrate contextual innovation and the capacity of instructors to compensate for systemic constraints by applying elements of design thinking and experiential modelling.

Figure 3 visualizes the relationship between the frequency of interactive method use (teachers) and perceived effectiveness (students). The radar chart highlights methods where instructional practice aligns with learner outcomes, as well as areas where adoption remains insufficient despite high pedagogical potential-an important indicator for further refinement of interactive and simulation-based learning models.

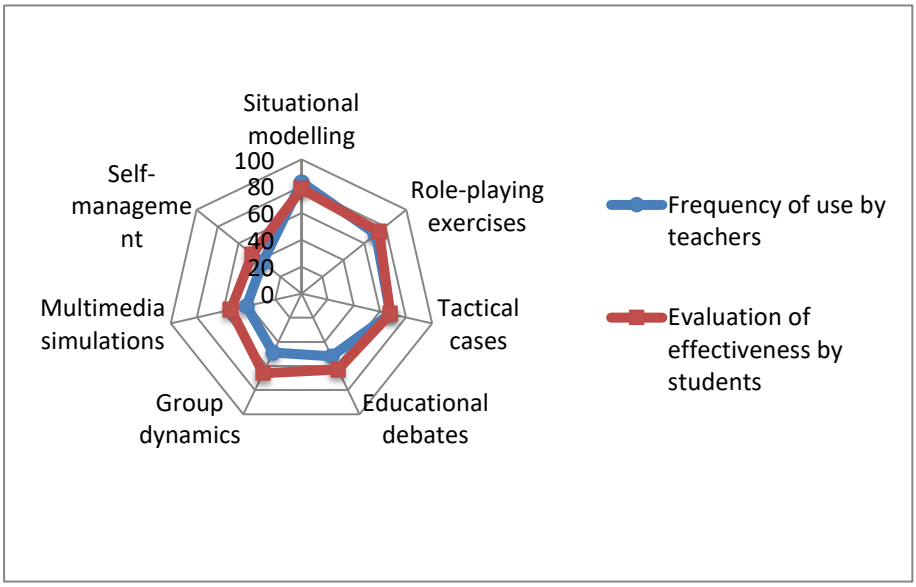

Figure 3. Comparison of the frequency of use of interactive methods by teachers and evaluation of their effectiveness by students
Source: created by the authors based on their own research.

Figure 3 shows the clear dominance of situational modelling, used in 83% of cases and assessed by students as the most effective (78%). Role-playing exercises, while employed less frequently (71%), received a high effectiveness rating (74%), although some teachers demonstrated insufficient facilitation skills. Tactical case analysis showed stable indicators both in frequency (68%) and effectiveness (68%), but was limited by difficulties in selecting meaningful material and providing supporting tools. These results reinforce the principles of experiential learning, where structured scenarios and reflective analysis directly influence the development of tactical reasoning and adaptive decision-making.

Educational debates (52%) and group dynamics (49%) were used less often, though group dynamics received strong student approval (66%). Its sensitivity to group composition highlights the importance of collaborative learning (CSCL), where group stability and interaction patterns significantly affect outcomes. Methods involving digital platforms-multimedia simulations (42%) and self-management (37%)-were irregularly applied and correspondingly received lower effectiveness scores (54% and 47%). Technical constraints, weak institutional support and the low formal status of self-management were the primary causes.

The inconsistency in the use of technology-enhanced formats indicates incomplete alignment with instructional design principles such as TPACK, where pedagogical, technological and content components must be balanced to ensure sustainability of interactive practices.

In the context of identified barriers, it was essential to analyse not only their presence but also their frequency and perceived importance across teachers and students. Focus groups revealed the most significant obstacles as limited technical resources, lack of training time and low institutional support. These findings illustrate a systemic gap between pedagogical needs and organizational conditions, constraining the adoption of simulation-based and interactive learning models. Figure 5 visualizes the distribution of these barriers, correlating them with general trends in method use.

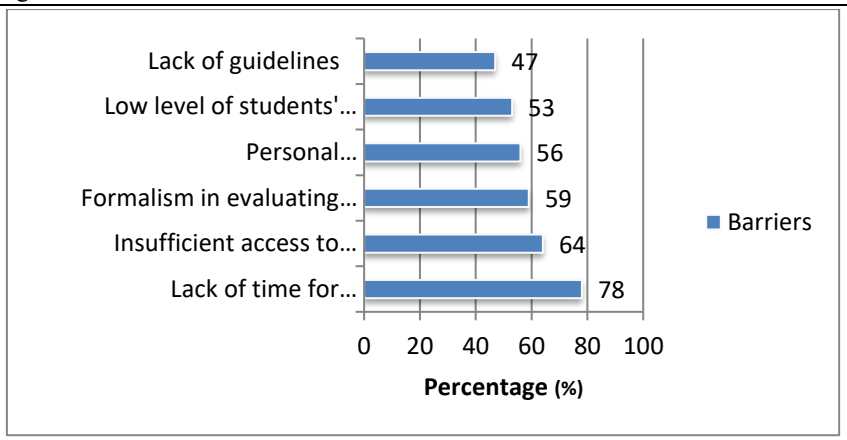

Figure 4. Main barriers to the use of interactive methods in military training (according to focus groups)
Source: created by the authors based on their own research.

Figure 4 illustrates the structure of the main barriers hindering the implementation of interactive methods in military training. The most frequently mentioned obstacle was the lack of time for class preparation (78%), reflecting teacher overload and limited capacity for planning non-standard activities. Limited access to digital tools (64%) highlighted uneven technical support and unstable infrastructure. Formalism in assessment (59%) pointed to a misalignment between modern pedagogical evaluation and traditional administrative procedures. Personal unpreparedness of teachers (56%) included motivational, psychological and methodological difficulties, including fear of reduced control during interactive work. Barriers related to student motivation (53%) and the absence of clear methodological instructions (47%) were less frequent but still significant. Together, these obstacles represent systemic constraints that reduce the feasibility of implementing collaborative and technology-supported learning models such as CSCL or SAMR-based digital integration. The structure of barriers also indicates insufficient alignment with TPACK, where the technological, pedagogical and content components must interact cohesively. Without stable digital infrastructure, professional development and updated assessment procedures, interactive and simulation-based methods cannot function as intended within experiential learning cycles. Expanded analysis enabled correlation of national findings with international models of officer reserve training. In many countries, interactive methods constitute a structurally integrated component of the educational process. A key trend is the institutionalization of digital simulators as a mandatory element of basic officer training, supported by regulatory frameworks, certified platforms (VBS4, JCATS, VR-Forces) and the development of digital pedagogy. This shift allows simulation technologies to operate not merely as instructional supplements but as core elements of decision-making, reflection and collaborative scenario analysis. Table 2 presents a comparison of approaches to interactive training in the countries considered, with an emphasis on the role of simulation technologies and their pedagogical positioning.

Table 2. Educational models of the officer reserve and the use of digital simulators

Country	Type of training programme	Availability of digital simulators	Stage of integration of simulators
Poland	University Reserve Training Programs (Akademia Wojsk Lądowych)	JCATS	Specialized module at the end of the course
Denmark	Officer Course at the Armed Forces (Forsvarets Officersskole)	VBS4	System integration in all phases
Finland	Officer Courses at the National Defence Academy (MPKK)	VR-Forces	Separate training blocks
Indonesia	National Military Academy (SESKOAD)	JCATS	Initial integration in practical classes
USA	ROTC Programme at Universities (Reserve Officers' Training Corps)	JCATS, VBS4	Full integration in the basic and applied phases

Source: created by the authors.

The generalization of the obtained results indicates established practices of using interactive methods with clear performance indicators and identifiable systemic barriers. The findings show that methods grounded in experiential learning, collaborative interaction and digital simulation provide the strongest contribution to the development of tactical adaptability and analytical-reflective skills, while their full potential remains constrained by institutional and infrastructural limitations. Overcoming these barriers requires targeted changes in the organization of the educational process, methodological support and digital infrastructure, as well as the gradual

alignment of training models with modern instructional design frameworks to ensure sustainable integration of interactive and technology-enhanced learning tools [32]-[34].

The results confirmed the effectiveness of situational modelling, role-playing and command-and-staff training in reserve officer preparation. This aligns with the conclusions of Caffery et al. [35], where the project-simulation approach enhances adaptability through the processing of non-standard situations. Although McGuire & Lockie [36] emphasised the role of physical training, the complementarity of cognitive load in simulations and physical endurance demonstrates the systemic nature of officer preparation. Such convergence reflects experiential learning theory, where practical and emotionally engaging tasks strengthen behavioural readiness and professional judgement [37]-[39].

Comparison with the application of case-based methods in Mizambayeva & Baimyrzayev [40] revealed similar reliance on after-action review as a mechanism for identifying errors and reinforcing decision-making. This corresponds with reflective practice models, in which structured reflection plays a decisive role in internalising tactical reasoning. The factors of simulation effectiveness identified in Nyström & Ahn [41] realism, role clarity and debriefing quality were likewise relevant in the present study, confirming their influence on coordination and decision speed within simulated operational environments.

The digital learning environment model proposed in Rybchuk & Yaroshov [42] supports the integration of CAX systems with tactical exercises. The present findings confirm the effectiveness of such hybridisation, where virtual modelling is combined with algorithmic practice to strengthen analytical and managerial competencies. Similar patterns reported in Scalese et al. [43], particularly in medical emergency simulations, reinforce the idea that technology-enhanced tasks activate both cognitive and affective readiness, which is a core requirement of contemporary instructional design in military education.

The importance of regulatory adaptation highlighted in Ryskulbekov et al. [44] is consistent with the present findings, which demonstrate that institutional support and methodological resources are critical determinants of interactive learning effectiveness. Gamification elements described in Švábenský et al. [45] improved engagement and skill acquisition, corresponding to the emotional intensity and decision-making dynamics observed in role-playing scenarios. Modular digital design approaches discussed in Stathakarou [46] also mirror the logic of CAX-based instruction identified in this study.

Leadership development through interpersonal interaction, as shown in Zhu et al.[47], correlates with the communicative and coordinative components inherent in role-playing exercises. The use of serious games in tactical combat casualty care training [48] and comprehensive game-based environments [49] further confirms the role of contextual modelling in strengthening stress resistance and concentration. These findings align with CSCL principles, where distributed cognition and coordinated action form the foundation of competence development.

Legal and organizational considerations for remote tactical training discussed in Pennings et al. [50] emphasise the necessity of regulatory frameworks to support digital integration—an aspect also reflected in the barriers identified in the present study, particularly those related to infrastructure and instructor preparedness. Evidence from the Indonesian defence education system Yogaswara [51] parallels the present results regarding improved motivation and performance in groups engaged in seminars and case discussions. These findings reaffirm previous research showing that affective factors play a significant role, as evidenced by observations of emotional load during tactical simulations [52]. This suggests that affective stability is a crucial competency supporting decision-making in high-pressure situations [53]-[55].

In contrast to previous studies, which predominantly examine interactive or simulation-based methods in isolation or within the context of active-duty military training, the present research provides an integrated empirical analysis of interactive practices specifically in reserve officer education within higher education institutions. The novelty of the findings lies in revealing a structural imbalance between the frequency of interactive method application and their actual instructional impact, as well as in demonstrating the differentiated pedagogical roles of simulations, case methods and role-playing exercises within a unified instructional design framework. Unlike earlier research, this study empirically substantiates the position of digital simulators as transformation-level tools (SAMR modification–redefinition) rather than auxiliary instructional aids, highlighting their function in managing cognitive load, supporting reflective cycles and enhancing collaborative decision-making.

The theoretical implications of the study extend current models of military pedagogy by empirically linking experiential learning, CSCL, SAMR and TPACK within the specific context of reserve officer training. The results support the refinement of instructional design theory by demonstrating how interactive and simulation-based methods jointly shape adaptability, analytical reflection and emotional regulation. The practical implications include guidance for restructuring military training courses toward scenario variability, strengthening instructor technopedagogical competence, revising assessment procedures to reduce formalism, and institutionalising digital simulators as core components of curricula. These implications provide a foundation for evidence-based modernization of reserve officer training in higher education institutions under conditions of operational uncertainty.

The research was limited to one HEI – Ivan Chernyakhovsky National Defence University of Ukraine – which does not allow extrapolating the results to the entire reserve officer training system. The technological

component of the study was also constrained by the specific digital infrastructure of this institution, which may differ significantly from other military education environments. As a result, the generalization of findings related to technopedagogical integration, simulator use and digital readiness should be interpreted with caution.

It is appropriate to expand the empirical research base by involving other types of educational institutions, introduce longitudinal monitoring of the implementation of interactive methods at different stages of training, and develop unified methodological materials for military training departments. Further research should also examine institutional digital capacity, evaluate technopedagogical competence among instructors, and pilot standardized models for integrating simulation technologies (VBS4, JCATS, VR-Forces) into military curricula. Such steps would support consistent implementation of interactive approaches and enhance the sustainability of technology-enhanced learning in officer training.

5. CONCLUSION

The results showed that interactive learning methods contribute to the activation of cognitive processes, the development of team interaction and the strengthening of adaptability under uncertainty. Situational modelling, role-playing exercises and the case method demonstrated the highest efficiency, confirmed both by their frequency of use and by positive student feedback. Digital simulators and instructive self-management remained less widespread due to technical and organizational barriers, primarily the lack of preparation time, insufficient digital infrastructure and the absence of clear methodological scenarios. The study empirically substantiates the internal structure of perceived method effectiveness and their alignment with the key educational goals of reserve officer training. An imbalance was identified between the high perceived value of certain methods and their actual frequency of implementation. Comparison with international models demonstrated that digital simulations are a standard component of basic military training in countries such as Poland, Denmark and the USA, emphasising the need to adapt this experience within the national context. The scientific contribution of this study lies in demonstrating how interactive and simulation-based methods can shape a modernised military curriculum, where adaptability, reflective analysis and collaborative decision-making become core competencies. The findings advance simulation-based instructional design by empirically confirming which methods most effectively support cognitive load management, team coordination and experiential reasoning in high-uncertainty environments. From a broader higher education perspective, the study contributes to digital pedagogy by showing how platforms such as VBS4 and JCATS can function not only as technological tools but as integral components of technopedagogical ecosystems aligned with contemporary frameworks of experiential learning and CSCL. Given these conclusions, it is appropriate to update methodological materials with an emphasis on digital platforms, develop instructor training programmes that include facilitation and self-management modules, and strengthen institutional support for interactive approaches through regulatory consolidation of their role in military training programmes.

USE OF ARTIFICIAL INTELLIGENCE (AI)-ASSISTED TECHNOLOGY

The authors declare that no artificial intelligence (AI) tools were used in the preparation, analysis, or writing of this manuscript. All aspects of the research, including data collection, interpretation, and manuscript preparation, were carried **out** entirely by the authors without the assistance of AI-based technologies.

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