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Innovative teaching methods of tactical disciplines for students studying in the programme of training of reserve officers for air defence of the Army

Abstract. The study aimed to reveal modern methods of training reserve officers for air defence of the Army. The study analysed the current state of teaching tactical disciplines to students enrolled in the reserve officer training programme and the existing problems in the context of military education. The requirements for professional qualities, knowledge and skills of military personnel were described. The essence and importance of tactical disciplines are revealed. A study was conducted among 95 students of Ivan Kozhedub Kharkiv National Air Force University and the National Technical University of Ukraine “Igor Sikorsky Kyiv Polytechnic Institute”, which demonstrated the lack of innovative technologies in the educational process, as well as the need to develop practical skills of future military personnel using modern approaches. The study identified problems that students face during the educational process, in particular: fear of making mistakes (45% of respondents), lack of confidence in their knowledge and abilities (40% of respondents), and lack of practical skills (35% of respondents). The results of the study necessitated the development of new approaches to the training of military specialists and the improvement of existing curricula. The study proposed innovative methods of teaching tactical disciplines and provided recommendations for their introduction into the educational process. Among the proposed methods are: the creation of a simulation environment using augmented and virtual reality, air defence simulators, the use of artificial intelligence, and the creation of special training laboratories. The study suggested improving the skills of teachers to work more effectively with innovative technologies, regularly monitoring the effectiveness of innovations, and exchanging experience with international partners. The results obtained will improve the training of future military specialists, which may affect the effectiveness of countering armed aggression against Ukraine

Keywords: modern approaches; information technology; specialised education; virtual environment; simulation modelling

INTRODUCTION

In modern society is actively undergoing digitalisation processes that determine the need for innovative approaches and new educational methods in the educational environment to meet modern requirements. The use of innovative methods in the educational process can improve the training of future professionals, influence their knowledge acquisition and facilitate the effective development of practical skills, which will have an impact on the quality of their future professional activities, the development of

their industry and the state as a whole. Due to the armed aggression against Ukraine, the use of innovative methods in the training of future military personnel has become increasingly important.

The use of the latest approaches in the military sphere, as well as in the educational process at military faculties and departments, was studied by V. Humeniuk *et al.* (2023), who also studied the use of innovative technologies at the Department of Military Medicine, D. Chopa *et al.* (2020),

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who analysed the peculiarities of using mobile applications in the study of military and technical disciplines, and M.L. Rusu (2023), who studied the culture of innovation in the military sphere. The researchers concluded that the modernisation of the educational process in today's realities is an important stage in the development of the state, which will allow the training of highly qualified specialists who will be competitive in the modern labour market and whose training will meet international standards. In the training of military specialists, the use of innovative methods can ensure a balance between theoretical knowledge and practical skills and influence the acquisition of the experience necessary for military service, which is especially important due to the special conditions in the country and the impact on the educational process. The military sphere requires regular design of innovative technologies and their application, as this allows to increase the accuracy and efficiency of military operations and respond quickly to the challenges of modern society.

Modern approaches to the training of future military specialists were revealed by J. Kosonen *et al.* (2023) in a study of the features of the use of modern educational resources in the educational process of future military personnel, as well as G. Wang (2024), who analysed the state of scientific research on military training and its prospects. The scientists noted that modern approaches to training military specialists can include flipped classrooms and expanded distributed learning, and that to modernise the educational process, it is necessary to develop the knowledge and skills of the teaching staff, improve the material and technical base and increase students' motivation to learn. However, no specific innovative methods of teaching disciplines to future military professionals were provided. In addition, the researchers concluded that the training of military specialists is currently based on outdated approaches, and the researchers identified the following problems that affect the decrease in the effectiveness of training future military personnel: outdated material and technical facilities, lack of motivation for students to study, lack of training models, including simulators that could be used to develop practical skills, which can reduce the quality of the educational process and contribute to a lack of practical skills.

The way to improve the training of future military personnel may be to introduce innovative approaches and methods into the educational process, but this process may also be accompanied by problems, as discussed by V. Chmyr & N. Bhinder (2023), who explored the challenges and prospects of using artificial intelligence in military training. R.P. Woźniak (2021) studied distance learning in the training of military specialists, and at the same time, I.S. Mert & C. Şen (2021), studied the features of professional military education. The researchers noted that the creation of an innovative educational environment for military professionals is important and necessary for them to acquire the necessary knowledge and counter armed aggression, but in the process of introducing innovations into the educational process, problems may arise, such as lack of material

resources to modernise the educational process; lack of skills to apply innovations, both among teachers and students; teachers' commitment to traditional teaching methods; data confidentiality issues and the possibility of leakage of confidential proprietary information. The availability of modern equipment may not be enough for effective digitalisation and modernisation of the educational process, as it requires special skills to use them, which requires teachers and students to adapt to new technologies and changes in the organisation of the educational process.

The main problems that exist in the current content of educational programmes for the training of military specialists are also identified in the Resolution of the Cabinet of Ministers of Ukraine No. 1490-2022-p (2022). The document states that the current system of military education does not meet the current needs and does not meet the challenges currently faced by the Armed Forces of Ukraine, and identifies the reasons for this situation: use of outdated methods of training military personnel; lack of innovative educational technologies, methods and approaches; low level of readiness of academic staff to use innovative technologies and teach modern educational programmes; ineffective system of responsibility for the quality of training of military specialists; lack of material and technical support (in particular, simulators, training systems, complexes, laboratories and modelling centres); lack of exchange of experience with other educational institutions.

The modernisation and digitalisation of the educational process at military faculties and departments is an important stage in the quality training of servicemen for future duties, which will ensure a balance between their knowledge and skills. However, innovative teaching methods in the analysed studies are not sufficiently disclosed, and there are problems both in the existing educational process (outdated material and technical base, lack of opportunities to develop practical skills) and in the possible innovative educational environment (lack of material resources for the implementation of innovative approaches, lack of skills to apply them). The study aimed to provide effective innovative approaches to teaching disciplines to future military personnel. The objectives of the study was to analyse the current state of training of reserve officers, as well as to provide recommendations for the introduction of innovative methods in the educational process to improve their effectiveness.

MATERIALS AND METHODS

This study involved 95 students. Among them are 50 students from Ivan Kozhedub Kharkiv National Air Force University, as well as 45 students at the National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute". The sample was formed randomly among students of military faculties and departments. For instance, among the participants of the study, 25 people from Ivan Kozhedub Kharkiv National Air Force University studied at the Faculty of Air Defence of the Army, and 25 people at the Faculty of Reserve Officers. Among the participants of the study from

the National Technical University of Ukraine “Igor Sikorsky Kyiv Polytechnic Institute”, all 45 people received their education at the military training department. The subjects were 22-25 years old, all male. All the subjects have different academic achievements, social status and different attitudes towards the research topic. Each of the subjects was trained in tactical disciplines. The survey was completely anonymous, and all the provisions of the The Declaration of Helsinki (2013) were followed. The information obtained was used exclusively for this study. A survey was conducted to identify the problems faced by students in the educational

process (in particular, when studying tactical disciplines), analyse their attitudes towards innovative technologies and the possibilities of their use in preparation for performing their duties. The study was conducted using the author’s questionnaire, which included 13 questions with the need to choose an answer that corresponds to the personal experience of the respondents (“Yes” or “No”) and two questions with the need to provide an open answer (Table 1). Due to the introduction of martial law in Ukraine and for security reasons, the survey was conducted online using information and communication technologies (Google Forms).

Table 1. The author’s questionnaire form for determining students’ readiness to apply innovations in their professional training

No.	Question	Yes	No
1	Have you had any experience in tactical training?		
2	Have teachers used innovative technologies/methods/approaches in teaching tactical disciplines?		
3	Do you have experience with innovative technologies/methods/approaches (in any area of your life)?		
4	Was this experience useful for you?		
5	Are you getting the knowledge you need for your future military career?		
6	Are you getting the skills you need for your future military career?		
7	Is there enough practical application of the acquired knowledge in your educational process?		
8	Do you think it is advisable to introduce innovative technologies/methods/approaches in tactical training?		
9	Do you think that the introduction of innovative technologies/methods/approaches in tactical training can improve your preparation for military activities?		
10	Are you ready for future military activities?		
11	Are you confident in your knowledge and abilities?		
12	Do you believe that your knowledge and abilities are sufficient to perform your future duties?		
13	Do you have a fear of making mistakes in the course of your future duties?		
14	Please indicate what problems you face in the educational process, and which could be solved by introducing innovative technologies/methods/approaches into the educational process.		
15	Indicate which innovative technologies/methods/approaches could be useful in solving the problems described.		

Source: compiled by the authors

The results of this questionnaire helped to analyse the state of the educational process and identify the problems that exist in the current training of reserve officers for air defence of the Army. Given the presence of open-ended questions, the problems faced by students in the educational process were revealed and innovative technologies/methods/approaches that could be effective in solving these problems were identified. The synthesis of the data obtained was carried out, which became the basis for providing recommendations for the implementation of the proposed innovative methods of teaching tactical disciplines in the educational training of reserve officers. Based on the synthesis of the data obtained, the author also draws general conclusions and identifies prospects for further research in this area. This study analysed the following regulatory documents: Law of Ukraine No. 1556-VII (2014); Resolution of the Cabinet of Ministers of Ukraine No. 48-2012-p (2012); Resolution of the Cabinet of Ministers of Ukraine No. z1678-15 (2015); Resolution of the Cabinet of Ministers of Ukraine No. 1490-2022-p (2022).

The analysis of these regulatory documents:

- revealed the legislative framework for the training of reserve officers for air defence of the Armed Forces and identified problems that need to be addressed;
- defined the concept of “military higher education institution” and its differences from civilian educational institutions;
- determined the role of quality training of military personnel based on the list of their state duties;
- defined the concept of “tactical disciplines” and their role in the training of reserve officers for the Air Defence of the Armed Forces.

RESULTS

The educational process in Ukraine is being transformed in line with the changes taking place in the international labour market to prepare competitive specialists in various fields. Training specialists capable of effective professional activity is a priority for higher education. Particular attention currently is devoted to the training of military

specialists in connection with the armed aggression against Ukraine. Therefore, the educational process in higher military education institutions, as well as at military faculties and military departments of civilian higher education institutions, has certain peculiarities and should be subordinated to the existing needs of the state. According to the Law of Ukraine No. 1556-VII (2014), a military educational institution is defined as a higher education institution that trains cadets (students) for further service as officers to meet the needs of the Armed Forces of Ukraine. This indicates that the training of military specialists should meet the current needs of the state and is currently important for the protection of Ukraine's sovereignty, territorial integrity and inviolability.

To ensure the state sovereignty, territorial integrity and inviolability of Ukraine, it is necessary to staff the Armed Forces and other components of the defence forces with motivated, educated and qualified military personnel, which can be achieved through a high-quality educational process and the use of modern technologies, in particular: samples of weapons and military equipment, simulators, training systems, complexes, laboratories and modelling systems for future specialists to acquire the necessary practical skills (Resolution of the Cabinet..., 2022). Practical skills are important for all military specialities, including air defence officers of the Armed Forces. The servicemen of this branch ensure the protection of civilians, and military and civilian objects from air attacks by cruise and ballistic missiles, and unmanned aerial vehicles, and contribute to the effective execution of ground operations, creating the necessary conditions for their high-quality and unhindered conduct. The performance of these duties requires not only in-depth knowledge but also high-quality practical skills that should be acquired as part of training in higher education institutions, because on the battlefield there must be a specialist capable of performing duties accurately, clearly and responsibly.

The basis for acquiring practical skills in higher military educational institutions and military departments is tactical (tactical specialist) disciplines, which are conducted in a certain area (training grounds, airfields, training centres) or special classes/laboratories and within which the skills necessary for performing official duties are formed and improved (Resolution of the Cabinet..., 2015). Tactical disciplines provide not only practical training for future military personnel but also strategic and psychological training. During the teaching of tactical disciplines, students develop an understanding of how their actions affect real-life situations, as well as psychological readiness for the responsibility they face and the possible consequences of their decisions and actions. This makes tactical disciplines important in the comprehensive preparation of future military professionals for their duties. However, given the problems that exist in the current content of educational programmes for the training of military specialists (Resolution of the Cabinet..., 2022), there is a need to find new approaches and innovative methods

to teaching tactical disciplines and changes in the training programmes for reserve officers for the Air Defence Forces.

To more specifically identify the problems that exist in the educational process during the practical training of future military personnel, which is necessary to provide effective innovative approaches to teaching tactical disciplines, a study was conducted among students of Ivan Kozhedub Kharkiv National Air Force University and the National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute" Among those surveyed, 85% (81 people) stated that they had experience with innovative technologies/methods/approaches in various areas of their lives, and 74% (70 people) considered this experience to be useful. This demonstrated the high role of innovative methods in modern society and their benefits in various spheres of life, which confirmed the need for their application in the educational process. While 98% of respondents (93 people) had experience in teaching tactical disciplines, only 56% of respondents (53 people) stated that teachers used innovative technologies/methods/approaches in the process of teaching tactical disciplines. This proved the need to revise approaches to teaching tactical disciplines and the need to improve training programmes for reserve officers for the Air Defence Forces. Regarding the acquisition of knowledge and skills necessary for future military activities, 93% of respondents (88 people) believed that they were acquiring the knowledge necessary for their duties, but only 66% of respondents (63 people) said they were acquiring the skills necessary for their duties. Overall, 47% of respondents (45 people) noted a lack of practical application of the acquired knowledge in the educational process. These results pointed to the need to introduce tools into the educational process that would allow students to apply the knowledge gained in practice and acquire the necessary practical skills to perform future duties. Such tools may include previously identified samples of weapons and military equipment, special simulators, training systems, complexes, laboratories and modelling systems.

The findings were confirmed by the fact that 91% of respondents (86 people) indicated that they consider it appropriate to introduce innovative technologies/methods/approaches to tactical training, and 80% (76 people) said that this could improve the teaching of tactical disciplines and, as a result, their preparation for future military activities. However, only 60% of respondents (57 people) said they were ready for future military activities. Only 63% of respondents (60 people) were confident in their knowledge and abilities, and 36% (34 people) said that they believed their knowledge and skills were not sufficient to perform their future duties. And 33% of respondents (31 people) said they were afraid of making mistakes in their future careers. This demonstrated low readiness for future professional activities and the need to change approaches to the educational process, including the practical application of acquired skills. The respondents were asked to indicate what problems they face in the educational process, and which could be solved by introducing innovative technologies/

methods/approaches into the educational process. Among the most frequently mentioned problems are fear of making mistakes, lack of confidence in their strengths and abilities, and lack of practical skills (Fig. 1).

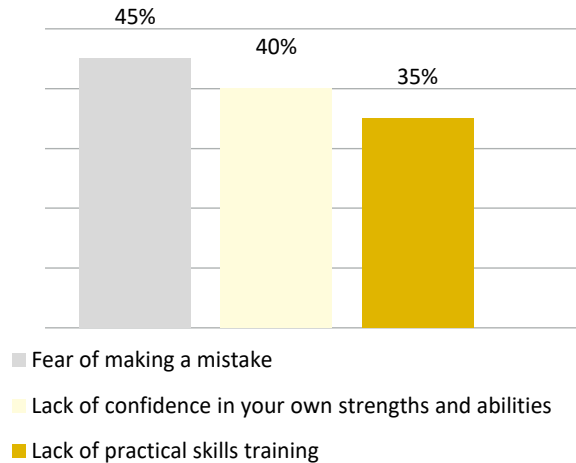


Figure 1. Problems faced by students during the educational process

Source: compiled by the authors

Less frequently, students reported fear for their health and life (20% of respondents) and fear of responsibility (12% of respondents), as their job duties involve a high level of risk and responsibility for the lives of others and their safety. Such results may demonstrate the need for psychological preparation of students for future military activities, which may be the prospect of further research. The respondents were also asked to indicate which innovative technologies they believe would be useful in solving the problems they face in the educational process. Innovative technologies are among the most frequently mentioned: artificial intelligence, virtual reality, special laboratories, and mobile applications (Fig. 2). Less often, students mentioned the need to use such methods as case-based learning (15% of respondents) and project-based learning (10% of respondents). Thus, the results of the survey demonstrated the expediency of changes in the existing military training programmes, as well as the need to introduce innovative methods into the educational process, as the surveyed students lack practical skills, lack of self-confidence, and are not ready for service, which can reduce its quality and effectiveness. To provide effective methods of teaching tactical disciplines, it is advisable to consider the basic requirements for the professional qualities, knowledge and skills of future reserve officers, as well as the competencies they should acquire in the course of their training for effective future professional activity since it is to implement these requirements that the content of the educational process, methods and approaches used are determined (Resolution of the Cabinet..., 2012).

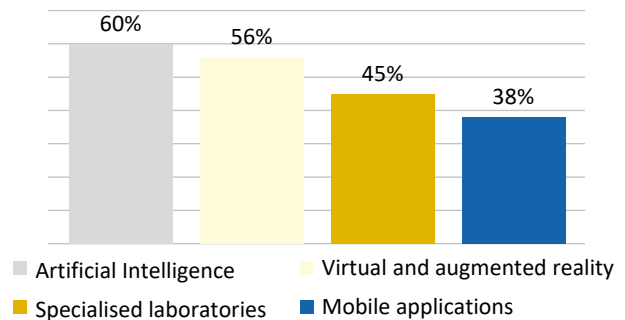


Figure 2. Innovative technologies that can be used to solve problems arising in the educational process
Source: compiled by the authors

Military competence in modern research is defined as a set of qualities that affect professional activity, ability and willingness to solve problems and tasks arising within it, using the acquired knowledge, skills, abilities, as well as values and culture (Benkovska, 2022). Military competence is also seen as a set of different knowledge and skills used in the performance of official duties (Fig. 3).

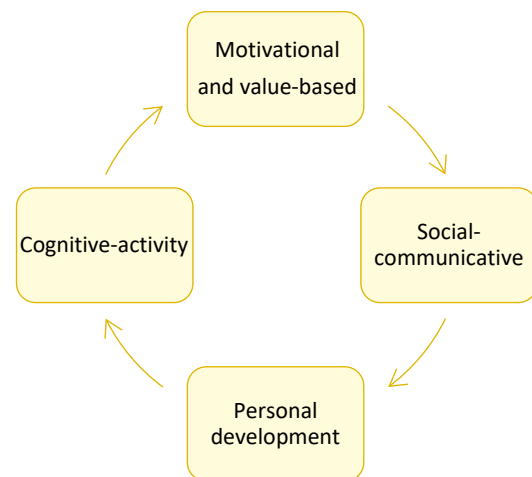


Figure 3. Blocks of knowledge, skills and qualities necessary for servicemen to perform their duties
Source: compiled by the authors based on O. Marchenko (2011)

The cognitive-activity block may include in-depth knowledge of the military sector and the ability to apply it in practice; cognitive skills necessary for effective performance (attention, analytical/critical/logical thinking, memory); flexibility, as the ability to adapt and quickly adapt to different conditions and situations. The motivational and value block may include motivation to perform official duties and to develop oneself as a professional throughout life; personal attitude to work and understanding of its importance; and personal values. The social-communicative block may include the ability to work in a team, the ability to understand requests, requirements and orders;

the ability to communicate effectively with others, and effectively resolve problems and conflicts that may arise while performing official duties. The personal development block may include the ability to self-development and professional improvement; unlocking one's potential; the ability to reflect; and the ability to take responsibility for actions.

Based on the requirements for the professional qualities, knowledge and skills of servicemen, innovative methods of teaching tactical disciplines for reserve air defence officers of the Armed Forces should develop the ability to quickly adapt to rapidly changing conditions on the battlefield, develop cognitive skills, motivate to perform official duties, form the ability to work in teams, motivate to continuous self-improvement and improve professional skills, provide opportunities to analyse their actions, their results and further adjust the strategy. Based on the information obtained during the study, the following innovative methods of teaching tactical disciplines to reserve officers are proposed: the creation of a simulation environment using augmented and virtual reality, air defence simulators, and artificial intelligence, and the creation of special training laboratories.

Artificial intelligence, which is a computer machine that can perform tasks, searching for information, generating ideas and performing other activities that normally require human intelligence, can be used to train reserve officers for the Air Force. The possibilities of its application in the training of military personnel are quite wide, in particular (Chmyr & Bhinder, 2023):

- ➔ the ability to simulate military missions and generate their results depending on the chosen options;
- ➔ the ability to plan operations and generate their results depending on the factors selected during planning;
- ➔ analysis and execution of various scenarios that may arise on the battlefield;
- ➔ designing plans;
- ➔ data analysis (e.g., analysis of the terrain features where the operation will be carried out, the approximate area of the territory where the operation will be carried out, and calculation of the results of the operation based on the selected factors);
- ➔ tracking of equipment health sensors or soldiers' health sensors.

In addition, artificial intelligence can be used by students in the process of self-education and improvement of their knowledge and skills to search for the necessary theoretical information, develop an individual study plan, learn foreign languages to interact with international partners, generate ideas. The introduction of artificial intelligence in the teaching of tactical disciplines can contribute primarily to the development of cognitive skills of military personnel because, despite its ease of use, artificial intelligence requires the input of accurate, consistent and logical data to perform tasks effectively and to search for the necessary information in a targeted manner (Baird *et al.*, 2024). In addition, artificial intelligence can be useful for analysing

certain actions and decisions, tracking their consequences and, if necessary, correcting them. Among the problems that may arise in the process of introducing artificial intelligence into the educational process is the lack of necessary competencies for both teachers and students to use them correctly and effectively.

Air defence simulators are trainers that mimic the operation of military equipment to recreate real situations in artificial environments (Kulik *et al.*, 2023). Modern simulators have different degrees of realism and can be used in different conditions. There are such simulators as live simulators, virtual simulators, and constructive modelling (Bhattacharjya *et al.*, 2023). Live simulations can be implemented at training grounds using real equipment but without its practical application. The advantages of live simulations can be the conditions in which they are implemented (for example, at training grounds, conditions can be as close to real ones as possible) and the ability to interact with real equipment that will be used during professional activities. The disadvantages of live simulators may be the impossibility of practical use of the equipment, as well as its accidental damage, which will cause material damage. In this regard, virtual simulators and the creation of simulation environments based on them can be safer and more effective. The creation of a simulation environment using augmented and virtual reality can be an effective method of practical training for future military personnel, which will help them practice their knowledge in situations and conditions close to real life.

Virtual reality is software that can be used to interact with a three-dimensional simulated environment in real time (Pallavicini *et al.*, 2016). Virtual reality can enable students to experience real-life situations on the battlefield, but without endangering their lives and health, without endangering others, and without material losses that may occur in the event of damage to real equipment and real means of warfare. By introducing a simulation environment using virtual and augmented reality into the educational process, students will be able to develop flexibility – the ability to quickly adapt to situations that may arise and change rapidly on the battlefield, and can also clearly see the results of their correct or incorrect actions, understand the consequences of their decisions and high responsibility and adjust their strategy to get the best result in real professional situations (Almer *et al.*, 2021). The simulation environment using virtual and augmented reality can be implemented in the form of a specially equipped place in the classroom or at a training ground, which will look as close as possible to real conditions, and special virtual reality devices (glasses and sensors) will create the effect of being on a real battlefield. Another method of implementing a simulation environment is to create special software or use existing software (for instance, Joint Conflict and Tactical Simulation or Battle Command) that would allow simulating real situations on the battlefield at different levels and of varying complexity.

Among the factors that can influence the effectiveness of student training within the simulation environment using virtual and augmented reality are the following: availability of the necessary material and technical support based on a higher education institution, the quality of the simulation environment and the availability of the necessary competencies of teachers who will train future military personnel in a simulation environment (Gawlik-Kobylińska *et al.*, 2020). If at least one of these factors does not meet the requirements, the effectiveness of teaching tactical disciplines using a simulation environment may be reduced, as the lack of material and technical support, its quality, and the readiness of teachers to use it in the

educational process are important aspects of quality and effective training.

The study by T. Kulik *et al.* (2023) describes such air defence simulators as OSA, TR-23 simulator, UST-1 GROM Training, NEWA SC simulator, TR-GROM MANPADS (Table 2). The use of these simulators is typical for the training of Polish military personnel, but since the Republic of Poland is a partner state of Ukraine, it allows for the exchange of experience between military educational institutions of both countries and in the future these simulators can be used in the training of Ukrainian military personnel, and therefore it is advisable to analyse the identified simulators and determine their advantages.

Table 2. Comparative characteristics of air defence simulators

Simulator	Description	Advantages
OSA	An air defence simulator that generates and practices specific scenarios that may arise in real-life situations on the battlefield with the ability to select conditions (day, night, weather conditions) and simulate a laser rangefinder.	The ability to choose the level of training of the student for comfortable and gradual development of practical skills; the ability to choose scenarios; and the possibility of team interaction.
TR-23	An air defence simulator is a mobile simulator using a monitor that displays a simulated image of a tactical situation, within which exercises are performed to detect, recognise, track and destroy air targets.	Possibility of team interaction; accessibility of the simulator; possibility of simultaneous training of a large number of people.
UST-1 GROM Training	A simulator designed for training in firing from a man-portable air defence system with the ability to evaluate the tasks performed according to selected criteria.	Ability to assess practical skills and correctness of tasks.
NEWA SC	A simulator based on real and augmented reality that simulates air raid scenarios with full simulation of objects, the environment, as well as the technical means used in real combat operations (for example, a copy of the missile system operator's consoles).	The ability to create combat scenarios according to selected criteria; the ability to analyse actions; accurate reproduction of real-world equipment.
TR-GROM MAN-PORTABLE AIR DEFENCE SYSTEM	A simulator designed to develop skills in interacting with man-portable air defence systems, allowing one to learn the features of their use in various virtual environmental conditions with simulated terrain, weather, atmospheric conditions and even sound effects. The simulator offers a large database of aircraft for practising skills in operating man-portable air defence systems and a wide range of scenarios with the ability to set own parameters.	Creating the most realistic environment possible; a wide base of scenarios with the ability to customise parameters and a wide base of aircraft

Source: compiled by the authors based on T. Kulik *et al.* (2023)

Thus, the advantages of virtual air defence simulators are the creation of the most realistic environment (simulating terrain, weather conditions, day or night, and even sounds), the ability to practice practical skills according to specified parameters (depending on the student's prior training, existing knowledge and skills, and field of study), the ability to select certain scenarios and practice them further, and the possibility of team interaction, which is an important factor in success on the battlefield, as well as the availability of equipment that can verify the correctness of the actions taken and exercises performed. However, such air defence simulators are expensive and may not be available to all higher education institutions, especially under martial law. In the context of limited resources, the most effective methods of improving the training of reserve officers for the Air Defence of the Armed Forces may be constructive modelling and the creation of special

laboratories at a higher education institution that will combine all the necessary methodological and possible technical means to gain in-depth knowledge of military activities and practice practical skills.

Constructive modelling includes the use of various computer programs without the use of virtual and augmented reality and without the need to visit training grounds. In this software, it is possible to train on certain scenarios based on the input of the necessary data, for example: speed and type of aircraft, their weapons, and weather conditions. The advantages of this method are accessibility and ease of use, while the disadvantages are the lack of a realistic environment and the inability to simulate the use of aircraft destruction tools. Establishing special laboratories in higher education institutions is also an affordable method of improving the teaching of tactical disciplines. These laboratories can have a mixed format and be partly presented

in an offline environment (classrooms, testing grounds) and partly in an online environment. In an online environment, such as an online repository, the teaching materials necessary for professional training can be stored: manuals, recommendations, and author's developments by university professors and leading experts in the military field. The offline environment may include available models of military equipment, computers with the necessary software (e.g., constructive modelling software) to practice practical skills, and, if available and feasible, additional virtual reality devices (glasses and sensors). In addition, teamwork can take place within these laboratories: brainstorming on military operations, discussion and analysis of military operations already conducted, development of communication skills, exchange of experience and moral support.

The combination of in-depth knowledge of their speciality and its practical application can improve the training of military specialists, and make it more effective, which can lead to better results on the battlefield. Based on the results of the survey and analysis of scientific sources, it was found that each of the proposed methods during their implementation in the educational process may have its shortcomings that should be eliminated to improve their effectiveness and increase the efficiency of professional training of future military personnel. Among the most common problems that may arise while introducing the proposed innovative methods into the educational process are the lack of special competencies of teachers to implement innovations and use them in the teaching process and the lack of experience of students in working with innovations in the educational process. To solve these problems, the study proposed regular professional development of teachers, exchange of experience with international partners, and regular monitoring of the effectiveness of innovations. Many teachers may be adherents of traditional teaching methods, and when innovative methods are introduced into the educational process, they may have problems with their use and, as a result, with the practical training of future military personnel. In addition, modern technologies are changing rapidly, as are their functionality and approaches to their application. Therefore, for the effective implementation of the proposed innovative methods, it is advisable to conduct regular professional development among teachers, in the field of modern technologies. Professional development can take place through attending specialised courses, seminars, and workshops, as well as listening to various lectures, taking online courses, and listening to webinars. In addition, an effective way to improve the qualifications of teachers and develop the knowledge and skills of future servicemen and women is to exchange experience with international partners, as the experience of European servicemen and women can be valuable in improving interaction with innovative technologies, as well as in improving them and increasing the effectiveness of military training.

Given that innovative methods are rapidly evolving and require constant improvement, regular monitoring of the effectiveness of innovations is recommended. This not

only tracks their effectiveness in teaching tactical disciplines, but also analyses their impact on military training, and improves them based on the needs of the educational process and students. The effectiveness of the proposed innovative methods can be monitored through regular surveys among students, selecting several exercises or tasks, the effectiveness, speed and accuracy of which will be compared over time, which will help assess how well the implemented modern approaches meet the purpose of the educational process and how effectively they develop the practical skills of future military personnel. To control the effectiveness of the implemented innovative methods, it may be advisable to conduct an experimental study of their effectiveness. Thus, to ensure the state sovereignty, territorial integrity and inviolability of Ukraine, military personnel must acquire certain knowledge, and competencies and have highly developed practical skills. However, the results of the survey showed that students perceive a lack of practical skills and experience to start their professional careers. Respondents also noted a fear of making mistakes and being held accountable during their future professional activities. In the modern world, these problems can be most effectively addressed by introducing innovative methods into the educational process, in particular: simulation environment with the use of augmented and virtual reality, air defence simulators, artificial intelligence, and special training laboratories. For more effective implementation of the proposed methods, it is advisable to improve the current competencies of teachers, monitor the effectiveness of the implemented methods, and exchange experience in the use of innovative technologies in military training with international partners.

DISCUSSION

The study determined that in the modern world, the military forces must be well-trained for the performance of official duties and have in-depth knowledge and highly developed practical skills. However, there are currently problems in the process of training future servicemen, in particular in the process of training reserve officers for the Air Defence Forces. To address the problems identified in this study, innovative teaching methods for future military personnel that can improve the effectiveness of their preparation for future professional activities were provided, and additional recommendations were made for their effective implementation in the educational process.

After analysing the peculiarities of the use of virtual reality technologies in military training, H. Zhong (2022) concluded that military training strengthens the combat capability of the army and the ability to effectively perform official duties, but it should be based on modern approaches, which correlates with the results of this study. These conclusions were also reached by M. Miller-Kopyt & A. Witzak (2022), who studied an interactive air defence simulator. The researchers noted that the effective operation of the state's military forces is possible only as a result of the use of modern methods and approaches and a

properly organised military training process. High-quality training of military specialists for the performance of official duties is possible within a higher education institution, which is also noted in the study of special military training in higher medical education by. The researchers concluded that in modern military training, there is a need for changes in the existing curricula, which was also identified in this paper. The study identified the creation of a simulation environment using augmented and virtual reality, air defence simulators, the use of artificial intelligence, and the creation of special training laboratories as innovative methods of tactical training of reserve officers.

In their study of simulation technologies in military medicine education, V. Rice *et al.* (2011) noted that the use of simulations of various types is an effective method of training specialists for future professional activities, and the researchers identify computer modelling and the use of virtual reality as the most effective methods, which correlates with the results of this study. Among the methods not disclosed in this study, researchers propose static and dynamic holograms, but they may not be available to all higher education institutions. The simulator as a method of effective training of military personnel was also considered in the study of a military training simulator based on virtual reality by R. Patil (2024). The scientist analysed the learning environment that allows you to practice practical skills without using real technical equipment. Such learning environments help students perform a variety of tasks in different conditions and terrains, analyse the data and assess their skills in real-time. The use of such virtual environments, according to the researcher, in addition to practising practical skills, improves leadership skills makes important decisions on the battlefield, and minimises the danger that may arise during training-on-training grounds using real equipment, which correlates with the results of this study.

Studying virtual reality methods for military training, C.U. Hinojosa & D.R. Arispe García (2023) also concluded that the main advantage of using virtual reality is that it does not require travelling to real training grounds, which is safer and requires fewer material costs, and will contribute to more effective training of students. H. Cardona-Reyes *et al.* (2024), studying the design of tasks for military personnel in virtual reality environments, noted that practising practical skills in virtual reality increases students' motivation to learn and helps them analyse their skills that can be applied in real professional situations, which correlates with the results of this study. G. Telli Yamamoto & D. Altun (2021), studying the prospects of virtual reality technologies in military training, concluded that virtual reality improves the perception and speed of information retention and can replace practical training on training grounds, and A. Sudiarno *et al.* (2024), analysing the performance of specialists after training using virtual reality, noted that the accuracy of practical skills in real and virtual conditions is quite similar, which proves the effectiveness of virtual air defence simulators. However, this study has determined that virtual reality may not be available to

all higher education institutions due to a lack of material resources. D. Maxwell *et al.* (2018), in their study of virtual reality entertainment devices in military training, also concluded that virtual reality technology may not be accessible to everyone. The researchers noted that there are currently affordable virtual reality systems, but their quality may be lower and, in some cases, provoke vision problems, which may affect further military activities and the quality of combat missions, which should be addressed but was not sufficiently disclosed in this study. Another disadvantage of virtual reality, which was not taken into account in this study, is that communication on the battlefield can be unstable, as noted in the study of military simulation training by J.J. Shen *et al.* (2009). While using virtual reality technologies, students are provided with high-quality mobile and Internet communications, and the opportunity to receive assistance and support from other military personnel without hindrance. In real-world conditions, such capabilities may be limited, which may reduce the effectiveness of military personnel on the battlefield, which should be taken into account when training military personnel using virtual reality.

Another innovative method of teaching tactical disciplines in this study is artificial intelligence. A. Khan *et al.* (2024), studying artificial intelligence in military training programmes, concluded that it is relevant in modern military training and facilitates data analysis and modelling, which helps to make more informed decisions about military operations and actions, which correlates with the results of this study. However, scientists note that the use of artificial intelligence for military purposes lacks an understanding of how this or that information is generated, which was not considered in this study. Military activities are responsible, and conditions during military operations can change rapidly, which is not always addressed by artificial intelligence. In addition, artificial intelligence is not capable of addressing all possible factors, which should be taken into account when using it to train future military personnel. Despite the large amount of information provided by artificial intelligence, it needs to be verified, and tools should be created to more transparently evaluate the information provided by artificial intelligence. M. Möbius *et al.* (2023), studying artificial intelligence for military decision-making, concluded that training with its use is an effective method of preparing military personnel for professional activities and can also be useful for decision-making, training in the use of equipment, planning of military operations and their optimisation, which correlates with the results of this study. The researchers also noted that for artificial intelligence to be more effective, it should be used in combination with other innovative methods, such as virtual and augmented reality or modelling. Among the possibilities of using artificial intelligence in military training that were not disclosed in this paper, the researchers noted the possibility of using it for cybersecurity and cyberattack resistance. This requires the development of a legislative framework for the use of artificial intelligence in the training of reserve officers, as well as verification of the safety of its use.

Speaking about computer modelling as an accessible method of training military personnel for professional activities, J.D. Fletcher & P. Chatelier (2000), analysing the possibilities of military training, noted that simulation is characteristic of military training, therefore, the use of software for this purpose is appropriate, which correlates with the results of this study. The researchers concluded that computer modelling makes the training process more realistic by creating different events and reproducing different scenarios under different conditions, which was also noted in this paper. Among the innovative methods of teaching tactical disciplines not disclosed in this study, A.F.A. Fadzliah *et al.* (2023), in their study of mobile games for military training, highlight mobile applications. The researchers concluded that gaming mobile applications and mobile applications specially designed for military training may be the most accessible and one of the most effective methods for military personnel to acquire the necessary knowledge and skills. To improve the effectiveness of the implementation of the proposed methods in the educational process, it was suggested that teachers should be trained, and experience exchanged with international partners. Both professional development for teachers and the exchange of experience for future military personnel can take place through cooperation with other educational institutions, with educational institutions of partner countries. In their study of public relations as a method of improving the competencies of military personnel, C.J. Gbaden & K. Kwapsoni (2022) noted that communication is the basis of any activity, including military, which proves the need to share experiences with other professionals. S. Barr *et al.* (2019) noted in their study of academic-practical partnerships in the training of military doctors that experience exchange, exchange programmes, and foreign internship programmes can be effective in acquiring practical skills, which correlates with the results of this study.

Military training is an important aspect of the development of a modern state, as well as a guarantor of the protection of its territorial integrity, which determines the need to change approaches to training future military personnel. Modern technologies such as virtual and augmented reality and the creation of simulation environments with their help, artificial intelligence, and computer modelling can be effective methods of teaching tactical disciplines, but they can also have certain disadvantages. Disadvantages: the inaccessibility of some modern technologies due to limited resources, inaccurate data, lack of realistic training, and privacy issues, which should be analysed and addressed. By improving the qualifications of educators and facilitating the exchange of experience with international partners, the implementation of the proposed methods can be made more effective and the training of reserve officers for air defence of the Armed Forces more efficient.

CONCLUSIONS

This study reveals innovative methods of training reserve air defence officers of the Armed Forces. The study determined that the use of innovative methods is an important part of

the educational process in military specialities since the processes of digitalisation combined with armed aggression against Ukraine require new approaches to the training of military personnel. Traditional methods and approaches to military training, including practical skills training, are currently insufficient, which requires finding ways to improve the educational process. The study also identified that some students believe they lack the knowledge and abilities to perform their future job duties. In addition, some respondents concluded that they have fears about their future professional activities, in particular: fear of making mistakes, lack of practical skills, and difficulties in understanding how to use the knowledge gained in real-life situations, rather than in the educational process. This pointed to the need for changes in the educational process and the importance of improving curricula and training methods. The respondents noted that effective approaches that can be used to improve the educational process could be: the use of artificial intelligence, virtual and augmented reality, the creation of special laboratories and the use of mobile applications.

Based on the information obtained during the study, the following innovative methods of teaching tactical disciplines were proposed: the creation of a simulation environment using virtual reality, air defence simulators, use of artificial intelligence, as well as the creation of special training laboratories, which will collect all theoretical information and will also preserve the possibility of its practical development. However, both teachers and students may have problems in the early stages of working with the proposed innovative approaches. Based on this, recommendations were made for their introduction into the educational process, in particular: professional development among teachers, which can ensure more efficient work with modern technologies and a better teaching process; regular monitoring of the effectiveness of the innovations applied to track their effectiveness and, if necessary, adapt them to specific conditions; exchange of experience with international partners, which can help to work more effectively with innovative methods and use all their capabilities.

The limitations of this study include the possibility of inaccurate and dishonest answers from respondents, which may be due to fear of being judged or losing confidentiality, as well as the insufficient number of respondents in the sample. The results obtained can be improved by involving a larger number of respondents, and prospects for further research may include an analysis of the psychological readiness of students studying under the programme of training reserve officers for the Air Defence Forces for professional activity, disclosure of methods of psychological preparation for the performance of official duties, as well as experimental testing of the proposed methods of teaching tactical disciplines.

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CONFLICT OF INTEREST

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Інноваційні методи викладання тактичних дисциплін для студентів, які навчаються за програмою підготовки офіцерів запасу для ППО Сухопутних військ

Анотація. Метою даного дослідження було розкрити сучасні методи підготовки офіцерів запасу для протиповітряної оборони Сухопутних військ (ППО СВ). В роботі було проаналізовано сучасний стан викладання тактичних дисциплін для студентів, які навчаються за програмою підготовки офіцерів запасу та існуючі проблеми в змісті військової освіти. Описано вимоги до професійних якостей, знань і умінь військовослужбовців. Розкрито сутність та важливість тактичних дисциплін. Проведено дослідження серед 95 студентів Харківського національного університету Повітряних Сил імені Івана Кожедуба, а також Національного технічного університету України «Київський політехнічний інститут імені Ігоря Сікорського», яке продемонструвало нестачу застосування інноваційних технологій в навчальному процесі, а також необхідність відпрацювання практичних навичок майбутніх військовослужбовців за допомогою сучасних підходів. За результатами дослідження було виявлено проблеми, з якими стикаються студенти в ході навчального процесу, зокрема: страх помилки (45 % опитаних), невпевненість у власних знаннях та здібностях (40 % опитаних), нестача відпрацювання практичних навичок (35 % опитаних). Результати дослідження обумовили необхідність розробки нових підходів до підготовки військових фахівців та удосконалення наявних навчальних програм. На основі проведеного дослідження було запропоновано інноваційні методи викладання тактичних дисциплін та надано рекомендації щодо їх введення в освітній процес. Серед запропонованих методів: створення імітаційного середовища з використанням доповненої та віртуальної реальності, симулятори ППО СВ, використання штучного інтелекту, а також створення спеціальних навчальних лабораторій. Рекомендовано підвищення кваліфікації серед викладачів для більш ефективної роботи з інноваційними технологіями, регулярний моніторинг ефективності інновацій, а також обмін досвідом з міжнародними партнерами. Отримані результати дозволять покращити підготовку майбутніх військових фахівців, що може вплинути на ефективність протидії збройній агресії проти України

Ключові слова: сучасні підходи; інформаційні технології; спеціалізована освіта; віртуальне середовище; імітаційне моделювання