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Peculiarities of pedagogical process in teaching technical disciplines with armoured vehicles and equipment to cadets of higher military educational institutions

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■ **Abstract.** The study aimed to analyse the impact of simulation equipment on cadet training and methods that combine theoretical training, practical training on equipment and the use of simulators. For this purpose, an experiment was conducted, during which the cadets completed a combined training programme that included both theoretical classes and practical exercises on real equipment, as well as on modern simulators. The analysis of the results showed a significant improvement in theoretical knowledge of 26% compared to the baseline, which indicates an improved understanding of the complex technical aspects of armoured vehicles and equipment. Moreover, the study showed that the practical skills of the cadets improved by 16.3%, reflecting an increased ability to apply theoretical knowledge in real-world situations. One of the key results of the study was an increase in motivation to learn by 89% of the cadets in the experimental group, which demonstrates increased interest and readiness to actively participate in the learning process. At the same time, the effectiveness of the methodology was found to vary depending on the individual characteristics of the cadets, and there are certain difficulties in adapting simulation methods to real combat conditions. The study also emphasised the importance of further consideration of the long-term impact of simulation technologies on cadet training and the need to develop individualised training programmes that will optimise the learning process for each participant. The study contributes to improving the methods of training military specialists and will help make training more effective and efficient in the future

■ **Keywords:** simulation methods; integration of technologies; practical skills; interactive methods; educational technologies; professional training; didactic approaches

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Introduction

In the conditions of active military operations and a significant threat to state sovereignty, the training of cadets of higher military educational institutions (HMEI) is of particular importance. This applies not only to the development of their physical and moral qualities but also to the acquisition of in-depth knowledge in technical disciplines related to the operation of the latest armoured vehicles. Given that modern armed forces are dependent on technical sophistication, the quality of officer training has a direct impact on the effectiveness of combat missions.

The problem of teaching technical disciplines with the use of armoured vehicles is the need to develop a high level of competence in cadets to effectively manage modern military equipment. Such tasks cannot be solved only through traditional teaching methods, so modern researchers emphasise the need to integrate innovative approaches. A. Dorofieiev (2024) addressed the international experience of officer training, in particular the use of simulation equipment to enhance practical skills. Y. Poltavets (2020) analysed the challenges faced by military cadets in mastering technical disciplines when using modern simulators. The technical training of cadets using armoured vehicles has its specifics due to the complexity of technical equipment and the need to use innovative methods. I.I. Zadorozhnyi *et al*. (2021) emphasised the importance of combining theory with practice. The authors highlighted that the simulators allow cadets to acquire the necessary skills in a safe environment as close to combat as possible. In addition, the use of simulation equipment helps reduce risks during training manoeuvres and reduces fuel costs and depreciation of equipment. The analysis by V. Terziev *et al*. (2017), which compared the development of professional skills of cadets trained under different military logistics programmes, is also noteworthy. Their research demonstrated that the use of simulators and simulations increases the level of readiness of cadets to perform tasks in the field. Another important aspect concerns physical training, which is also an integral part of the cadets' professional activities. G. Iedynak *et al*. (2020) addressed the impact of the military pentathlon on the physiological performance of cadets, emphasising the importance of integrating physical training with technical curricula. I. Bloshchynskyi *et al*. (2021) addressed the psychological and physical readiness of cadets to perform tasks in combat. They emphasised that the combination of physical and technical aspects of training allows cadets to be more confident and ready to perform combat missions.

Another important aspect is the pedagogical models of cadet training. A. Bolotin (2015) emphasised the importance of integrating physical training into the educational process of military educational institutions. The author demonstrated that physical training, including the use of simulators, is a key component in the development of cadets' professional readiness. Studies also show that military education faces certain challenges, including a lack of resources for training, but also that there is room for improvement, as shown by V. Banabakova & M. Georgiev (2017). Training cadets for the effective use of weapons and military equipment and performing combat missions is a complex process that requires constant improvement of pedagogical methods and curricula. Existing research provides different perspectives on how to address these issues, but there are still many aspects that need to be further explored and integrated into educational processes. The study sought to examine the influence of simulation equipment on cadet training, as well as techniques that combine theoretical instruction, practical equipment training, and simulator use.

Materials and Methods

The study was conducted at the military higher educational institution, which trains future officers for the Armed Forces of Ukraine. The main purpose of the study was to identify effective teaching methods that will help cadets develop the necessary knowledge and skills to successfully use armoured vehicles in modern warfare. The participants included 150 cadets, aged between 18 and 22 years. The participants were selected randomly, but the cadets' previous training and their level of technical proficiency were considered. The cadets were divided into two groups: an experimental group and a control group. The experimental group used the latest teaching methods with an emphasis on the practical use of armoured vehicles, while the control group was taught using traditional methods.

The experiment lasted for one academic semester (5 months) and included both theoretical and practical training. Most of the practical training was conducted at the training ground, where the cadets had the opportunity to apply their knowledge on real models of armoured vehicles. The training programme included studying the structure and principles of operation of the main systems of the equipment, diagnostics and repair, as well as training in firing and driving combat vehicles in various terrain conditions. To ensure the objectivity of the research results, standardised tests were used during the experiment to assess the cadets' knowledge and practical skills. The research was conducted in accordance with The American Sociological Association's Code of Ethics (1997). The study involved a wide range of technical equipment. Simulators were used in the training process to practice armoured vehicle control skills in conditions as close as possible to real combat operations. Statistical methods were used to analyse the results of the study. An analysis of variance was conducted to assess the impact of new teaching methods on cadets' performance, which determined the level of significance of the results. Pearson's

correlation coefficient was used to identify correlations between the level of theoretical training and practical skills of cadets. The study was based on the integration of modern pedagogical technologies, including the use of simulation training and active teaching methods.

Results and Discussion

The study was aimed at gradually immersing cadets in the practical aspects of operating armoured vehicles, based on a combination of theoretical knowledge and intensive practical training. Its main goal was to ensure the effective acquisition of knowledge and skills necessary for future service by maximising the integration of theoretical material with real-world conditions of armoured vehicles. The preparatory stage of the study involved familiarising the cadets with the main technical characteristics of armoured vehicles, structural elements, and the principles of operation of main systems (engine, transmission, weapons system, electronics, etc.). At this stage, the cadets learned the theoretical basis of equipment operation and safety rules when working with it. Lectures were supported by videos, 3D models of equipment and interactive diagrams. The main goal of this stage was to provide a thorough understanding of how the equipment works, allowing cadets to work with it safely and confidently in the subsequent stages of training. The cadets received basic knowledge about the operation of armoured vehicles but did not yet come into direct contact with the equipment.

At the stage of simulation training, the cadets started working on interactive simulators that reproduce the management and operation of armoured vehicles in real conditions. Simulators provided an opportunity to practically learn how to control a combat vehicle in a safe environment (Lee & Schamburg, 1995; Golovan *et al*., 2024). The cadets performed a variety of tasks: from simple manoeuvres to complex tactical operations, such as moving equipment over rough terrain, performing combat manoeuvres under enemy fire, engaging targets and coordinating actions within a unit. Simulators not only helped cadets learn the basic skills of driving equipment but also allowed them to practice them repeatedly without exposing the equipment to wear and tear or using fuel (Khizhnaya *et al*., 2016). The simulators reproduce various conditions – from standard to extreme (at night, in poor visibility or case of damage to equipment). During the practical stage, the cadets worked directly with real combat vehicles. After mastering the theoretical foundations and performing exercises on simulators, the cadets were ready for the real operation of the equipment on training grounds. Primary practical skills included driving armoured vehicles on different types of terrain (asphalt roads, off-road, rough terrain); maintenance (diagnostics of equipment, replacement of damaged elements, checking safety systems); live-fire exercises, tactical manoeuvres on vehicles.

Mentors monitored training directly, correcting mistakes and providing recommendations for improving performance. Cadets gained experience, which is as close as possible to real combat conditions. After completing the preliminary stages, the study involved combined classes that used theoretical knowledge, simulation exercises and real-life practice. The cadets trained on complex combat scenarios that reflected specific tactical tasks. This could include the development of an offensive plan, practising defensive actions, or coordinating with other units. The students improved analytical skills, teamwork and decision-making under pressure. Classes were conducted on the principle of "action analysis" – after completing each task, the cadets analysed mistakes together with their teachers and discussed how to avoid them in the future. At the final stage, the study involved comprehensive tests and practical tasks that could be used to assess the level of training of each cadet. The tests covered both theoretical knowledge (questions on the operation and maintenance of armoured vehicles) and practical skills (driving vehicles, performing combat missions at the training ground, and shooting). In addition, an important element was the assessment of cadets' psychological readiness to perform combat missions, and their ability to act under stress and coordinate in a team (Rojas-Ballesteros *et al*., 2019; Telelim *et al*., 2020). After completing all stages of training, teachers and cadets conducted a detailed analysis of the course, considering the strengths and weaknesses of each participant. This approach not only assesses the level of training but can also be used to adjust future curricula to the individual characteristics of each cadet. The step-by-step approach allowed the cadets to gradually immerse in the learning process, ensuring better learning. The combination of theory and practice allowed cadets not only to understand how the equipment works but also to use gained knowledge in practice. The use of simulators increased the effectiveness of training, reducing the risks and costs of real equipment. Interactive feedback can be used to constantly adjust the learning process, which contributes to effective learning of the material (Derevianchuk, 2023). This methodology not only ensured a high level of training for the cadets but also increased their psychological readiness to work in combat conditions. The cadets can complete all stages of training in a safe environment, which helps them perform duties confidently in real combat situations. The following pedagogical methods were used in the study, each of which was adapted to the specifics of the technical training of future officers of armoured units.

Use of interactive simulators. Modern interactive simulators allow recreating various combat situations, providing cadets with the opportunity to acquire practical skills in managing armoured vehicles without risking lives and without substantial financial costs. The study employed two main types of simulators:

armoured vehicle control simulators – models that simulate the control of tanks, armoured personnel carriers and other types of armoured vehicles in various conditions, such as rough terrain, training grounds or urban areas; combat simulators – simulators that model combat operations, including firing from various types of weapons, tactical manoeuvres, coordination of actions within a unit, and other combat tasks. Such simulators are used to train cadets in conditions as close to real life as possible, without risking life or damage to equipment. An important advantage is that simulators can model various combat scenarios, including unexpected attacks, technical malfunctions, or situations requiring immediate decision-making (Matlary, 2018; Degtyarenko, 2023). Simulators can be used to quickly correct errors in real-time, which significantly improves training efficiency. They also save resources, such as fuel and ammunition, and reduce wear and tear on equipment.

Usage of adaptive learning. Adaptive learning involves the creation of individual curricula for each cadet based on their initial level of knowledge and abilities. For this purpose, modern educational platforms that can track the progress of each cadet in real-time and adjust the learning process according to the results were used. *Integration of augmented reality technologies into the educational process.* Augmented reality has become an important part of the training process, enabling virtual training for cadets. These simulators can be used to learn the internal structure of armoured vehicles and perform virtual maintenance and diagnostics. The cadets were able to interact with virtual reality models, practice technical manipulations, and interact with electronic systems of armoured vehicles. Interactive three-dimensional models of machinery significantly improve the learning of complex technical aspects. The cadets can examine the design of various parts of the equipment in detail and study the principles of their operation and interaction in real conditions. This increased the level of cadets' involvement in the learning process and made it much easier to understand complex technical information.

Using gamification in the educational process. Gamification elements were introduced to stimulate competition and interest in learning. The cadets received points for completing their assignments, which allowed them to compete, see their place in the overall ranking and motivate them to achieve better results. This approach has significantly increased interest in learning and fostered healthy competition. In addition to traditional simulations, special training games were developed to model tactical situations. The cadets competed in tactical tasks, which helped develop not only practical skills, but also teamwork, analytical thinking, and decision-making under stress and uncertainty. *The project-based training involved cadets cooperating in small groups to solve real combat situations.* For instance, cadets were asked to develop a plan for a combat operation using armoured vehicles, accounting for all aspects of tactics, logistics and coordination with other units. This not only deepened knowledge but also developed critical thinking, leadership skills and teamwork. Each project was based on real-life combat situations, with which cadets could apply their knowledge and skills in practice. This developed the ability to make quick decisions in difficult conditions and to use armoured vehicles following the specific situation. *Psychological support for cadets.* Training under the stress of preparing for combat conditions requires the introduction of psychological support. The cadets had access to psychological counselling, providing advice on stress management and readiness for emergencies. As part of the training, stress management classes were held to help cadets learn to control emotions in difficult conditions and act effectively even under pressure. This significantly increased psychological stability and readiness for combat missions.

The use of the latest teaching methods, such as interactive simulations, adaptive learning, project-based learning and gamification, has significantly improved the training of cadets in military educational institutions (Prontenko *et al.*, 2019; Miroshnichenko *et al*., 2023). The cadets gained better theoretical knowledge and practical skills, which helps better prepare for combat missions. These techniques demonstrated significant potential for further implementation in military training programmes. The study focused on such aspects as cadets' theoretical knowledge, practical skills, overall performance, and satisfaction with the learning process. The results are presented in four key areas, including assessment of theoretical knowledge, practical skills, overall performance and feedback from cadets. One of the important aspects of the study was to determine the impact of the new methods on the level of theoretical training of cadets. For this purpose, testing was carried out, covering basic and advanced aspects of the management and maintenance of armoured vehicles. The main goal was to compare the effectiveness of the new approaches with traditional teaching methods, based on the test results of the two groups: experimental and control.

Both groups of cadets (experimental and control) had a similar level of theoretical training at the beginning of the study. However, after the introduction of the latest methods in the educational process, the experimental group recorded a significant improvement in results compared to the control group. The test results showed that the experimental group, which was taught using the latest methods, significantly improved its level of theoretical knowledge. The 26% increase in the average score in the experimental group confirmed that the use of interactive approaches, simulations and other modern technologies contributed to better learning. The control group, which was taught using traditional methods, also showed some improvement, but

the growth was much smaller – by 10.2%. This showed that traditional methods no longer provide the necessary efficiency for training future officers.

In addition to theoretical knowledge, an important aspect of the study was the assessment of practical skills, namely, operating armoured vehicles, performing maintenance and live firing. These skills are critical for military professionals, as they are directly related to the performance of combat missions in real-world conditions. As part of the practical training at the training ground, cadets were trained on armoured vehicle driving. The tasks included overcoming various obstacles, performing complex manoeuvres on rough terrain and controlling equipment in difficult conditions (nighttime, limited visibility. The accuracy of armoured vehicle fire was assessed by the following parameters: sight accuracy, firing speed and number of hits on target. The results showed that the cadets in the experimental group significantly improved their driving skills and shooting accuracy. In particular, the average time for completing tasks at the test site was reduced by 2.5 minutes, and the number of errors decreased by 2.3 times. The accuracy of the experimental group increased by 16.3%, while the control group increased by only 5.8%. This indicated that the use of modern simulators and simulations in the learning process contributes to the better development of practical skills.

The overall performance of the cadets was assessed on a scale from 0 to 100 points. The latest techniques have shown a positive impact on academic performance, especially in technical disciplines related to armoured vehicles. The analysis of academic performance in technical disciplines showed that the cadets of the experimental group achieved better results than the control group, which again underlines the effectiveness of the new approaches. A significant increase in the average score (by 21.1%) in the experimental group confirms that the latest methods provide better results in technical disciplines. In addition to theoretical knowledge, they contribute to the improvement of practical skills and the overall performance of cadets, which is a key factor in the effective training of future officers. The results of this study confirmed that the introduction of the latest teaching methods in the process of training cadets of military educational institutions significantly improves the quality of knowledge and practical skills. The cadets of the experimental group demonstrated a significantly higher level of training in all key aspects of the educational process. Positive feedback from the cadets also showed a high level of satisfaction with the new approaches. These data can be the basis for further improvement of the educational process of technical disciplines in military educational institutions and the introduction of new innovative approaches. The study confirmed the thoughts that the introduction of the latest teaching methods, in particular active methods and the use of simulation equipment, has a significant positive impact on cadets' performance. The results of the experimental group, which showed an increase in the level of knowledge and practical skills by 26% and 16.3% respectively, indicate that the integration of modern technologies into the learning process contributes to better learning and the development of the necessary skills. Based on the study, the following recommendations were offered. It is necessary to continue researching the long-term effects of using simulation equipment on the level of professional training of cadets. It is important to develop individualised approaches to training, considering the level of training and psychophysical characteristics of cadets.

These results are consistent with the findings of N. Hristov (2018), where it was demonstrated that the use of interactive teaching methods, in particular simulations, significantly improves the performance of students of technical specialities. A similar approach was studied by O.I. Kamaiev *et al*. (2018), who found that the integration of simulation equipment into the educational process leads to an 18% increase in cadet performance, which is consistent with the results of the study. However, the results of the study are different from the conclusions of A. Lytvyn *et al*. (2024), arguing that the effectiveness of simulation training depends on the individual characteristics of cadets and is not guaranteed to have a significant impact on overall performance. On the contrary, the study showed that even if individual differences are present, the overall level of knowledge and skills of the cadets is significantly improved. The study also demonstrated a significant improvement in the practical skills of the cadets in the experimental group, especially in the areas of armoured vehicle driving and shooting accuracy. This improvement was confirmed by a decrease in average task completion time and a reduction in the number of errors.

The results of the study supported the conclusions of Yu.V. Chovniuk *et al*. (2023), who noted that the introduction of practical training using modern simulators increases the effectiveness of training and the level of training of cadets. They proved that the use of simulators in tactical driving training improved navigation skills in difficult situations on the battlefield among cadets, which is consistent with the results showing significant improvements in driving skills. One of the important aspects of the study was to determine the relationship between theoretical knowledge and practical skills of the cadets. The results showed that the new teaching methods contributed to both the improvement of theoretical knowledge and practical skills. This suggests that the integration of theoretical and practical components into the learning process is a key success factor. According to the study by N. Huzyk *et al*. (2019), this approach to learning contributes to better knowledge acquisition and skill development. The authors argued that cadets studying using an integrated methodology demonstrate a higher level of success in both

aspects of learning. The results of the study confirmed this conclusion, showing that the integration of theoretical knowledge and practical skills leads to an increase in the quality of learning.

The findings opened prospects for further research in the field of military pedagogy. It is worth addressing the long-term impact of new teaching methods on the professional training of cadets. It is also worth investigating the impact of integrating different types of simulators and curricula on the effectiveness of training in other military specialities. Research that focuses on developing individualised approaches to teaching cadets with different levels of training, accounting for individual characteristics and needs, is promising. This is especially relevant in the context of modern requirements for military education, which are constantly changing. It is possible to argue that the study significantly contributed to the development of pedagogical science by offering new effective approaches to teaching technical disciplines in military universities, which will undoubtedly contribute to improving the quality of cadets' training and their readiness to perform their duties.

Conclusions

The study found that the introduction of the latest methods of teaching technical disciplines using armoured vehicles to military cadets significantly improves the quality of training. In particular, the study confirmed that the combined use of simulation equipment and traditional teaching methods improves cadets' theoretical knowledge by 26% and practical skills by 16.3%. The study demonstrated that the integration of modern technologies into the educational process improves learning efficiency and as well as readiness to perform duties. The findings demonstrate the importance of the systematic use of simulators in training, which reduces the number of errors during practical tasks and increases the accuracy of combat operations. Qualitative indicators are also important, such as improving cadets' concentration during the learning process and increasing their motivation to learn. This increase in motivation was observed in 89% of the cadets in the experimental group.

The results of the study indicated that the introduction of the latest methods of teaching technical disciplines using armoured vehicles is an effective approach to the training of military cadets. This was confirmed by a significant improvement in both theoretical knowledge and practical skills of the cadets in the experimental group. The results obtained are consistent with the research of other scientists and confirm the effectiveness of integrating modern pedagogical technologies into the educational process. At the same time, some aspects, such as the impact of simulation training on long-term outcomes, require further research. In the future, the study could be expanded to examine the impact of the latest teaching methods on the training of cadets in other military specialities and to adapt the results to be used in civilian education in technical disciplines.

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Conflict of Interest

None.

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Особливості педагогічного процесу в аспекті навчання технічних дисциплін із використанням бронетанкового озброєння та техніки в курсантів вищих військових навчальних закладів

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■ **Анотація.** Метою даного дослідження був аналіз впливу симуляційного обладнання на підготовку курсантів, та методів, що комбінують теоретичне навчання, практичні заняття на техніці та використання тренажерів. Для цього був проведений експеримент, під час якого курсанти пройшли програму з комбінованого навчання, що включала як теоретичні заняття, так і практичні вправи на справжній техніці, а також роботу на сучасних тренажерах. Аналіз отриманих результатів показав суттєве покращення теоретичних знань на рівні 26 % порівняно з початковими показниками, що свідчить про покращення розуміння складних технічних аспектів бронетанкового озброєння та техніки. Крім того, дослідження показало, що практичні навички курсантів покращились на 16,3 %, відображаючи підвищення здатності застосовувати теоретичні знання у реальних умовах. Одним із ключових результатів дослідження було зростання мотивації до навчання на 89 % курсантів експериментальної групи, що демонструє підвищену зацікавленість і готовність до активної участі у навчальному процесі. Водночас було виявлено, що результативність методики може варіюватися залежно від індивідуальних особливостей курсантів, а також існують певні труднощі з адаптацією симуляційних методів до реальних бойових умов. Також підкреслено важливість подальшого розгляду довготривалого впливу використання симуляційних технологій на підготовку курсантів та необхідність розробки індивідуалізованих навчальних програм, що дозволять оптимізувати навчальний процес для кожного учасника. Дослідження сприяє покращенню методик підготовки військових спеціалістів і допоможе зробити навчання більш ефективним та результативним в майбутньому

■ **Ключові слова:** симуляційні методики; інтеграція технологій; практичні навички; інтерактивні методики; освітні технології; професійна підготовка; дидактичні підходи