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MODERN APPROACHES TO TRAINING ARTILLERY CADETS USING SIMULATOR TECHNOLOGIES: LESSONS FROM THE WAR IN UKRAINE

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Abstract. The ongoing war in Ukraine has demonstrated the continued importance of artillery in large-scale combat operations. At the same time, the conflict revealed substantial changes in the way artillery units are employed on the modern battlefield. The widespread use of unmanned aerial vehicles (UAVs), counter-battery radars, precision-guided munitions, and electronic warfare systems has increased the requirements for artillery personnel training.

This article examines current approaches to artillery cadet training with particular attention to simulator technologies and digital learning systems. The paper analyzes the role of fire-control simulators, UAV coordination training systems, and tactical command simulators in preparing future artillery officers for modern combat conditions. Based on observations from the conflict in Ukraine, recommendations are proposed for improving artillery education programs through the integration of simulation-based learning.

Keywords: artillery training, military education, simulators, UAVs, artillery officers, combat training, modern warfare, Ukraine.

Recent military conflicts have shown that artillery remains one of the principal means of fire support on the battlefield. The war in Ukraine especially confirmed the decisive influence of artillery on operational and tactical outcomes [1]. However, the conditions in which artillery units operate have changed considerably compared with previous decades.

Modern artillery systems function in an environment characterized by constant reconnaissance, rapid target detection, electronic interference, and high-precision strikes. The battlefield has become more transparent due to the extensive use of drones and digital surveillance technologies. As a result, artillery crews are forced to change firing positions frequently and minimize the time spent at firing sites [2].

Under such conditions, the requirements for training artillery officers are also changing. Traditional methods based mainly on theoretical instruction and occasional field exercises are no longer fully adequate. Military academies increasingly require training methods capable of reproducing realistic combat situations while maintaining acceptable financial and logistical costs.

Simulator technologies represent one of the most effective tools for solving this problem. Modern simulators make it possible to train artillery cadets under conditions that closely resemble actual combat operations while reducing ammunition expenditure and equipment wear.

The purpose of this article is to examine the role of simulator technologies in the preparation of artillery cadets based on lessons observed during the war in Ukraine.

Changes in artillery operations during the war in Ukraine

The conflict in Ukraine demonstrated several important changes in artillery warfare.

First, UAVs became an essential element of artillery operations. Drones are now widely used for reconnaissance, target acquisition, fire adjustment, and battle damage assessment [3]. In

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many cases, artillery effectiveness directly depends on the speed of interaction between drone operators and firing units.

Second, the role of counter-battery warfare increased significantly. Modern radar systems are capable of detecting artillery positions within a short period after firing. Consequently, artillery crews must rapidly relocate after completing fire missions. The so-called “shoot-and-scoot” tactic has become a standard operational requirement [4].

Third, artillery units now operate under constant threat from FPV drones and precision-guided munitions. This requires improved camouflage, mobility, and survivability measures.

These operational realities indicate that future artillery officers need broader competencies than before. In addition to traditional artillery knowledge, cadets must understand drone operations, digital communications, electronic warfare, and battlefield information systems.

The importance of simulator technologies in artillery education

Simulator-based training has become increasingly important because it allows military institutions to intensify practical instruction without excessive operational costs.

Live-fire training remains essential, but it has several limitations:

high ammunition consumption;

equipment degradation;

fuel expenses;

limited training areas;

safety restrictions.

Simulation systems partially solve these problems by allowing repeated execution of combat scenarios under controlled conditions [5].

Modern artillery simulators can reproduce:

artillery fire missions;

target acquisition procedures;

UAV-guided fire correction;

communication disruptions;

electronic warfare effects;

counter-battery threats.

As a result, cadets gain practical experience in decision-making and tactical coordination before participating in field exercises.

Another important advantage of simulator training is the possibility of creating stressful operational conditions. Time pressure, incomplete information, sudden enemy detection, and communication failures can all be simulated in a controlled environment.

This aspect is particularly important because modern artillery officers must make rapid decisions under highly dynamic combat conditions.

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Types of simulators used in artillery training

Fire-control training simulators

Fire-control simulators are used to train cadets in the technical aspects of artillery employment. These systems support instruction in:

ballistic calculations;

weapon aiming;

target engagement procedures;

battery coordination;

correction of artillery fire.

Digital fire-control simulators are especially valuable because they allow cadets to work with electronic maps and automated command systems similar to those used in operational units [2].

Compared with traditional classroom instruction, simulator-based learning improves practical understanding and accelerates skill development.

UAV coordination simulators

The war in Ukraine clearly demonstrated that artillery and UAV operations are closely interconnected [3].

For this reason, artillery cadets increasingly require training in:

receiving targeting data from drones;

adjusting fire using aerial imagery;

coordinating with reconnaissance teams;

operating under conditions of signal interference.

Specialized UAV-artillery simulators can reproduce real-time interaction between drone operators and artillery units. Such systems allow cadets to practice communication procedures and fire adjustment in realistic tactical situations.

Training of this type helps future officers understand the importance of rapid information exchange within reconnaissance-strike systems.

Tactical command simulators

Tactical simulators are used to train battery and battalion commanders in battlefield decision-making.

These systems model:

changing tactical conditions;

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enemy artillery activity;

counter-battery fire;

equipment losses;

communication disruptions.

Unlike purely technical simulators, tactical systems focus on leadership and operational coordination.

The experience of the war in Ukraine suggests that adaptability and speed of command are often decisive factors in artillery effectiveness [4]. Therefore, command simulators play an increasingly important role in military education.

Future development of simulator-based training

One promising direction in artillery education is the use of virtual reality (VR) technologies.

VR systems can recreate realistic battlefield environments and improve immersion during training. Cadets may train under simulated:

drone surveillance;

artillery strikes;

low-visibility conditions;

urban combat environments.

Such technologies improve not only technical skills but also psychological preparedness.

Artificial intelligence may also become an important element of future military simulators. AI systems can analyze cadet performance, identify weaknesses, and automatically adjust training complexity.

In the future, simulator systems are likely to become more integrated, combining artillery operations, UAV control, reconnaissance, and electronic warfare into unified digital training environments.

Conclusion

The war in Ukraine has demonstrated that artillery continues to play a central role in modern warfare. At the same time, artillery operations have become more technologically complex and highly dependent on digital coordination and reconnaissance systems.

Under these conditions, artillery officer education requires significant modernization.

Simulator technologies provide an effective solution for improving practical training while reducing operational costs and increasing training intensity. Modern simulators allow cadets to practice technical procedures, tactical decision-making, and coordination with UAV operators under conditions close to real combat.

Consequently, simulator-based training should become one of the central elements of contemporary artillery education systems.

Future artillery officers must be prepared not only to operate weapons systems but also to function within integrated reconnaissance-strike networks characteristic of modern warfare.

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