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THE IMPACT OF ARTIFICIAL INTELLIGENCE ON MILITARY EDUCATION AND TRAINING

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Abstract:

The rapid evolution of artificial intelligence (AI) and machine learning (ML) presents enormous potential in education. Military education and training require exploration of the integration of artificial intelligence into learning and training systems to improve educational results and military skills.

This article aims to analyze the current use of artificial intelligence, outline the benefits and challenges associated with its integration, and assess its impact on ethical aspects and responsibility. This paper provides a comprehensive analysis of the literature, focusing on relevant sources and current official documents issued by NATO, the European Union, and national institutions, in order to document the process of integrating artificial intelligence into the military domain.

Despite significant limitations, such as data protection problems and the complexity of artificial intelligence and machine learning systems, the results obtained highlight the potential of these technologies to profoundly transform educational processes by facilitating personalized training tailored to the individual needs of learners.

Key words: education; training; military exercises and evaluation; artificial intelligence; AI ethics; governance.

1. Introduction

Artificial intelligence (AI) is deeply transforming various sectors, and the military is no exception. As modern warfare becomes increasingly dependent on information, speed, and precision, the need for more intelligent, adaptive, and technologically integrated training systems in military institutions is more pressing than ever [12]. AI is a large class of software capable of performing functions similar to those of humans, such as problem solving, prediction, and learning. Today, when people talk about "*artificial intelligence*" they often refer to machine learning (ML), a subcategory of AI that develops its functionality by identifying patterns in data [24]. By leveraging the capabilities of artificial intelligence and machine learning, large volumes of data can be analyzed, patterns can be identified, and relevant information can be generated for both students and instructors. This process provides real-time feedback and allows educational content to be tailored to each learner's level of knowledge, learning pace, and cognitive style [13].

Some experts consider that artificial intelligence "*are to understand the phenomenon of human intelligence and to design computer systems that can mimic human behavioral patterns and create knowledge relevant to problem-solving*" [16]. The relevance of artificial intelligence in the military domain is constantly growing, but its use must respect human values and ethical principles.

According to the report *Artificial Intelligence and the Future of Teaching and Learning: Insights and Recommendations* [6], significant progress has been made in integrating artificial



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intelligence into education, which can provide a solid foundation for further developments. The authors emphasize the importance of a well-articulated public dialogue around three key questions [6]:

1. *What are the main opportunities and risks associated with the use of AI in education?*
2. *How can the development of safe and reliable educational AI solutions be ensured?*
3. *How can the algorithmic models behind AI applications be understood so that they reflect qualities aligned with the values and objectives of educational systems?*

These lines of reflection are essential for building an ethical, effective, and equitable framework for the use of artificial intelligence in education.

The general objective of this article is to highlight the importance of applying artificial intelligence in military education and training, with a focus on the concrete benefits that these technologies can bring in streamlining the learning process and continuously adapting military personnel to the demands of a rapidly evolving technological battlefield.

This article also examines the potential, limitations, and future prospects regarding the ethical and governance considerations of integrating artificial intelligence into the military education system, highlighting the need for a balanced approach aimed at optimizing technological advantages and minimizing associated risks.

An objective remark is that it is recognized *"the need for a balance between leveraging AI's potential benefits in military operations while upholding moral and legal standards. The inclusion of these ethical principles serves as a foundation for responsible and accountable use of AI in the complex and dynamic landscape of military scenarios"* [1].

Research methodology. In this article, the research methodology was based on a qualitative-descriptive method, grounded in the examination of specialized literature, strategies, and plans regarding AI in the military domain from various organizations and developed countries, as well as educational policies implemented in various military institutions. The research also analyzed concrete examples of countries that have successfully regulated artificial intelligence in training and education activities.

Content analysis was used to identify the main benefits of using AI, but also to highlight the difficulties, limitations, and possible ethical risks generated by the application of this technology in the area of military education and training.

The research results demonstrate that integrating artificial intelligence into military training offers a number of notable advantages. These include more efficient training through the use of intelligent simulations, tailoring educational content to each trainee's profile, and more efficient management of large volumes of data. However, the application of AI also involves certain risks, such as increased dependence on technology, possible breaches in the protection of sensitive data, and a decline in the development of fundamental military skills, which are formed through direct practical experience.

2. Benefits and Opportunities of Artificial Intelligence in Military Education and Training

Artificial intelligence offers substantial potential to improve the quality of military education, bringing significant advantages in various areas of application. A key benefit is the increased efficiency of the training process and the expansion of large-scale application capabilities, as AI can take over certain tasks from teachers and training staff, such as *automatic training and testing*,



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making processes more efficient.. For example, "AI can support adaptive learning (also called personalized learning) where AI monitors a person (or team) and then offers recommendations based on their characteristics and behaviors" [24].

Artificial intelligence has the potential to take over a number of repetitive and administrative tasks from teachers and training staff, such as automating teaching and assessment processes, thereby contributing to increased efficiency and optimisation of human resources. In particular, Generative AI offers advanced capabilities for the rapid development of educational materials, including the automatic generation of tests, study programs, and tailored teaching content. It can transform teaching materials into structured *e-learning modules* and provide personalized feedback and evaluations for participants based on rubrics set by instructors. In the domain of military training, Generative AI enables the creation of a wide range of realistic simulation scenarios, facilitating the exposure of personnel to varied operational situations and thus contributing to the development of decision-making capabilities and resilience in conditions of uncertainty. [24].

Autonomous weapon systems represent a significant advance in military technology, operating without direct human intervention. Beneficial military applications include intelligent decision support systems and assisted target recognition, which can reduce the mental load on operators, enabling more rapid decision-making [23]. This approach offers advantages such as rapid response times, the ability to operate in high-risk environments, and reduced danger to human personnel [2]. *Training in the use of artificial intelligence* is becoming essential for military personnel because they need to familiarize themselves with the technology required to operate, understand, and/or neutralize these systems. Integrating AI into military education not only facilitates the effective use of these technologies on the battlefield, but also contributes to the development of a critical attitude towards potential vulnerabilities, limitations, and associated risks.

Artificial intelligence can provide organizations with in-depth information on the level of preparedness of military personnel, thus contributing to informed decisions on training and resource allocation. By analyzing a wide range of data from individual trainees, teams, or subunits, AI enables a more accurate assessment of the state of preparedness. For example, artificial intelligence can integrate and analyze data such as test results, physical behaviors recorded by video systems during practical exercises, and instructor observations. Based on these sources, AI can *generate predictive models* that estimate the readiness of a soldier, team, or subunit in relation to established tasks.

Wargames are also an essential method in military education and training, providing a safe environment for testing courses of action, improving decision-making, and exploring complex scenarios without the direct consequences of actual conflict. These simulations are not intended to accurately predict future conflict, but rather to develop the ability to adapt to uncertainty [4]. In this context, the integration of generative artificial intelligence opens up new perspectives for the evolution of war games. Recent experiments demonstrate that AI can contribute significantly to increasing the realism of simulations, automatically generating complex scenarios, modeling the behavior of the actors involved, and providing real-time decision support.

Another key benefit of artificial intelligence in military education is the integration of *virtual reality* (VR) technology into tactical training programs. Through VR, military personnel are introduced to virtual, realistic, and dynamic combat environments that reproduce complex operational conditions. This form of training facilitates intensive experiential learning, enabling the rapid development of reaction, decision-making, and coordination skills in high-stress situations, in a controlled and safe environment [14]. The integration of artificial intelligence and virtual reality technologies into military education and training not only optimizes the learning process through realistic and adaptive simulations, but also provides a training environment that reflects the



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complexity and unpredictability of real combat situations. In this way, military personnel acquire combat skills, develop their ability to react in dynamic environments, and are better prepared to face the challenges encountered in theaters of operations.

Furthermore, AI-assisted learning ecosystems enable *learning analytics*, helping to identify capability gaps, anticipate future military performance, and assess overall force readiness. Thus, artificial intelligence becomes an essential tool in optimizing training processes and supporting decisions regarding the training of human resources in the military.

Artificial intelligence is integrated into the *CAISR system* to support combat units by automating difficult tasks and providing decision support in war scenarios. Proper training and education enable military personnel to understand, use, and optimally leverage AI capabilities, particularly in terms of data fusion and analysis. Thus, artificial intelligence, combined with well-trained personnel, significantly increases the ability to collect, process, and exploit information, providing analysts with more accurate warnings and powerful tools for decision-making and more reliable intelligence analysis [27].

To address the current challenges associated with the implementation of artificial intelligence and to move toward concrete measures, Chmyr and Bhinder proposed five strategies that could beneficially influence higher military education through AI technologies, as follows [7]:

- *incorporate AI in curriculum* - the integration of AI content and applications into military educational programs;
- *develop AI digital competency* - training students and teachers in the effective use of AI technologies;
- *develop regulations when using AI within the educational process* - establishing explicit guidelines for the responsible application of AI in education;
- *develop AI-based methodology* - adapting teaching processes using AI tools and solutions;
- *increase teacher's innovative competency* - stimulating creativity and openness among teachers towards new technologies.

According to the same authors, the most common uses of artificial intelligence in education include: e-learning platforms, educational games and simulations, assessment tools, personalized learning systems, learning management platforms, and data analysis.

3. Ethical and Governance Considerations

The rapid development of artificial intelligence-based technologies in the field of defense has outpaced the pace of adaptation of the legal and regulatory framework. This lack of synchronization has raised concerns internationally, prompting numerous calls for the development of uniform regulations and firm ethical principles to ensure the responsible and controlled use of AI in military applications.

Although the benefits of integrating AI into military education are numerous, there are also significant challenges and risks that require careful management.

To ensure safe and effective use, artificial intelligence systems must be transparent in their decision-making, and their implementation must be accompanied by adequate user training. Users must understand both how these technologies work and their limitations in order to prevent potentially dangerous errors. In sensitive areas, such as the military or medical fields, a problem of



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responsibility may arise, as operators or professionals do not exercise direct control over the decisions generated by generative AI systems [23].

A correctly informed perception of the use of artificial intelligence in training and learning processes is essential because, in a democratic society, the public can directly and indirectly influence developments in the field of AI *"driven by inaccurate narratives and conspiracy theories and (mis)information presented on social media"* [15].

According to some experts, the challenges in integrating AI into military education are [12]:

- *data security and privacy*: The use of artificial intelligence in military education involves major risks to the security of sensitive data. Protecting this data from cyber attacks and unauthorized access is essential, and AI systems must be rigorously secured to prevent the compromise of information or the training process;
- *high costs of implementation*: budget constraints, especially in developing countries, can limit the adoption of AI solutions. Ongoing expenses for updates, security, and technical support accentuate the challenge of balancing innovation with financial sustainability;
- *technological infrastructure limitations*: the lack of reliable technological infrastructure limits the effectiveness of artificial intelligence systems in military education. Effective AI integration depends on advanced technological infrastructure, including high-speed networks, cloud computing, and advanced processing units;
- *overdependence on AI and skill degradation*: excessive use of artificial intelligence-based systems risks leading, over time, to an erosion of critical thinking, leadership, and decision-making autonomy. These abilities are essential in operational contexts marked by uncertainty, pressure, and urgency;
- *ethical and legal concerns*: Training in sensitive areas such as autonomous weapons or cyber warfare involves complex moral dilemmas. To comply with international laws and military codes, strict governance and careful oversight are essential.

In most countries, the ethical issues and responsibilities associated with the use of artificial intelligence in the military sphere have been treated with increased attention. Authorities have recognized the importance of establishing clear principles to guide the development and application of these technologies in accordance with moral and legal norms. The use of artificial intelligence in the military must comply with international humanitarian law and be conducted in a responsible, transparent, and appropriately human-controlled manner. They recommend conducting legal reviews, ensuring rigorous oversight, properly training staff, thoroughly testing systems, and adopting measures to reduce risks, errors, and associated biases [32].

Continuing this scientific paper, I will present the main reference documents regulating the use of artificial intelligence in the defense sector, as formulated in the legislative framework of representative organizations and states. This necessity for regulation has been recognized by several international organizations. The United Nations (UN), through the Group of Governmental Experts on Emerging Technologies in the Area of Lethal Autonomous Weapons Systems [30], has initiated debates on banning or limiting the use of AI in lethal weapons, calling for significant human control to be maintained in lethal decision-making.

The European Union has also emphasized in its Regulation laying down harmonized rules on artificial intelligence [10] the importance of developing artificial intelligence systems that are consistent with European values. Within the EU, particular emphasis is placed on the principles of



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transparency, accountability, and respect for fundamental rights, including in military applications [11].

Countries are focused on getting the technological edge in artificial intelligence to boost their competitive advantages in areas like military capabilities, economic productivity, and technological progress. In this context, NATO member countries have paid special attention to emerging and disruptive technologies that can be used in defense, as well as the challenges that come with innovation in this sector. NATO adopted its first *Artificial Intelligence Strategy* in October 2021 [19], and a revised version of this strategy was launched at the Washington Summit in July 2024 [20].

USA. The Department of Defense has classified artificial intelligence as a technology with disruptive potential for defense and has included it among the critical technological capabilities that require investment and priority attention. AI, together with machine learning and autonomous systems, is seen as a catalyst for innovation in the military domain, contributing to the development of systems that can support combatants by improving the speed, quality, and accuracy of decision-making in the field. These are key factors in gaining an operational advantage that can deter or ensure success in a conflict [26].

The main documents regarding AI regulation in the US civil and military sectors are:

- DOD Directive 3000.09 Autonomy in weapon systems 2012, revised in 2023 [32];
- DOD Adopts Ethical Principles for Artificial Intelligence [33];
- U.S. Department of Defense Responsible Artificial Intelligence Strategy and Implementation Pathway [34];
- America’s AI Action Plan, 2025 [35].

The ethical principles governing artificial intelligence are based on five essential values, which include [33]:

- *responsible*: Using AI systems responsibly means people need to use good judgment and be responsible when developing, implementing, using, and getting results from these systems;
- *equitable*: reducing as much as possible the occurrence of errors or unintentional biases in artificial intelligence systems;
- *traceable*: artificial intelligence capabilities will be developed and implemented in such a way that relevant personnel have an adequate understanding of the technology, development processes, and associated operational methods. A key aspect of traceability is transparency, which allows the human user to understand not only the result, but also the process by which it was obtained;
- *reliable*: AI-based capabilities will have clearly defined uses, and their safety, security, and effectiveness will be verified and ensured throughout their entire lifecycle;
- *governable*: Artificial intelligence systems will be designed and developed to perform their intended functions, identify and avoid unintended consequences, and allow for deactivation or interruption of operation in the event of unforeseen behavior.

UK. In the context of the 2025 Commanders' Conference organized in Athens, an event that brought together military leaders and specialists from the member states of the North Atlantic Alliance, discussions were dedicated to the prospects for the development of professional education in the defense and security domain. On this occasion, Major General Peter Rowell, commander of



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the United Kingdom's Defense Academy, noted that: *"Artificial Intelligence will transform education. It was great to be with so many allies and partners to discuss how we can lead the way"* [9].

Some of the reference documents on IA regulation:

- Defence Artificial Intelligence Strategy [29];
- British Army's approach to artificial intelligence - A guide to accelerate the Army's adoption of AI and get the Army AI ready [5].

The main idea of the defense documents emphasizes the institutional commitment of the armed forces to the ethical, transparent, and efficient use of artificial intelligence, so *"the Army is a trusted and responsible user of AI, integrating human-centred AI across the whole force for decision advantage"* [5].

France. The French military strategy on artificial intelligence, called *Artificial Intelligence in Support of Defense* [25], clearly highlights concerns about ethics and responsibility, which are explicitly addressed in the concept of *"controlled artificial intelligence"* which involves maintaining active human oversight of automated processes. In support of this approach, a *Defense Ethics Committee* was created with an advisory and monitoring role. Among the most relevant contributions of the Defense Ethics Committee within the Ministry of Armed Forces are two key initiatives:

- Opinion on the Augmented Soldier [17];
- Opinion on the Integration of Autonomy into Lethal Weapon Systems [18].

Romania. It actively joins NATO and European Union initiatives on defense digitization and strengthening emerging capabilities, areas in which artificial intelligence plays an essential role. These efforts are not limited to modernising training and education processes in military education, but also aim to strengthen institutional resilience and increase the capacity to respond to new types of hybrid and cyber threats in an integrated manner. In support of these objectives, Romania has adopted a series of strategic reference documents, such as:

- National Strategy on Artificial Intelligence 2024-2027 [21];
- National Strategy for the Development and Support of Digitalization through Digital Innovation Centers in Romania 2024-2027 [22].

Romania places special emphasis on developing these capabilities, so that the National Strategy for Artificial Intelligence 2024-2027 *"constitutes a necessary and timely reference point for preparing Romanian society to understand, accept, and capitalize on the transformative processes generated by artificial intelligence"* [21].

An example of the integration of artificial intelligence in military education is within the *Center for Modeling and Simulation of Military Actions* and the *Robotics and Artificial Intelligence Laboratory* (CUB) at the Land Forces Academy, which uses modern modeling and simulation equipment and state-of-the-art software, such as VBS3 and VBS4, for researching and experimenting with the battlefield in virtual reality, thus contributing to the development of cognitive skills within the military training component of Land Forces students [3].

In an environment of increasingly complex and technologically advanced global security, governance and ethics in the use of artificial intelligence are becoming essential components of the process of integrating this technology into defense and military education. NATO and the European Union agree on the need for clear, transparent, and responsibly constructed regulatory frameworks to ensure that AI is used in accordance with democratic values, international law, and human rights principles. This framework is all the more relevant in military education and training, where



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decisions made with the support of AI must be constantly subject to critical evaluation and human accountability.

Although artificial intelligence offers multiple benefits, its unsupervised or abusive use can compromise the quality and integrity of research. *Taylor and Francis*, one of the world's leading academic publishers, points out that AI-based studies can introduce errors, biases, or inconsistencies, manipulate content and citations, and generate false material such as deepfakes or synthetic text [28].

4. Conclusions

The integration of artificial intelligence-based technologies into military education and training is a transformative endeavor with significant implications for the effectiveness of military training and the ability of armed forces to adapt to current and future challenges. The use of intelligent tutoring systems, adaptive learning environments, and realistic AI-assisted simulations contributes to the individualization of the educational process and to improving the quality of instruction and training by optimizing decision-making and leveraging complex data analysis in real time.

The process of modernizing the armed forces, including education, requires the integration of innovative technologies into an effective system of collaboration between the military and technology, with the aim of optimizing operational performance and reducing existing deficiencies. However, the use of artificial intelligence in this context raises significant challenges related to the balance between human control and system autonomy, as well as the financial and technical feasibility of developing, maintaining, and operating these advanced capabilities.

The continuous development of human capital is a fundamental requirement. Professional training programs for teachers, military personnel, students, and other relevant actors must facilitate a thorough understanding of the mechanisms, opportunities, and limitations of artificial intelligence. Only through systematic training tailored to the digital context can skills remain relevant in the era of emerging technologies.

I consider that the application of artificial intelligence in education differs from one discipline to another, as the adoption of these technologies depends on the individual decision of instructors, often influenced by the lack of a legal framework and dedicated methodologies. However, where AI tools are integrated, they contribute significantly to the diversification of educational resources and to improving the quality of the teaching-learning process.

For a significant period of time, there has been a transition to the *"era of artificial intelligence"*, a context that requires a reassessment of approaches to digital education. Given the rapid pace of technological progress, separating learners from digital tools is becoming an unrealistic and ineffective approach to learning. The implementation of e-learning solutions in military education and training is characterized by short modules, concentrated content, increased flexibility, and the possibility of adaptive learning.

In the long term, educational and defense policies must focus on creating a framework of trust in the use of AI, anchored in social perceptions and respect for democratic values. Hybrid training models, which combine the efficiency of AI with human analytical capacity and responsibility, are emerging as sustainable solutions for modernizing military education in the context of future security.



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