

# DIGITAL TRANSFORMATION OF MILITARY EDUCATION IN NATO USING E-LEARNING

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## **ABSTRACT**

*The digital transformation of military education is a priority process within NATO, accelerated by technological advances and the need to maintain a high level of operational readiness in emerging situations. The article analyses E-learning solutions in the Alliance’s military educational structures, with a focus on the ADDIE and LWA models. The research uses a mixed (qualitative-quantitative) methodology, combining documentary analysis of NATO policies and standards, case studies, and comparative analysis of the models implemented. The results highlight that the implementation of E-learning contributes to increasing the accessibility, flexibility, and efficiency of military training, reducing costs and allowing for the personalization of the educational process. However, challenges include cybersecurity, interoperability, and resistance to change.*

**KEYWORDS:** ADDIE model, digitization, E-learning, LWA model, military education

## **1. Introduction**

Learning, in its most fundamental sense, is the acquisition of knowledge, skills, and attitudes, evidenced by a change in behavior. It is a process through which individuals assimilate and internalize information, ideas, and values, gain knowledge, develop skills, and improve their overall abilities. Learning occurs through personal reflection, cognitive reconstruction, social interaction and practical application. It can take place in formal, non-formal or informal contexts and can be both conscious and unconscious. As a continuous and, evolving process, learning develops gradually, building on previous knowledge, experiences, and beliefs, and is shaped by the environment (NATO, 2015). Vocational training is a well-defined educational path focused on the learning process and associated with the concept of continuing education (Cioranu, Cucinschi & Scipanov, 2024).

The digitization process is totally fundamentally changing the education system – not just distance learning – and it is making us take a long, hard look at its basic ideas and teaching methods. In the literature, *“online education is not simply a change in the learning environment, a shift from the classroom to the online space, but constitutes a new educational paradigm”* (Banciu, 2020). In this context, clear limits to the transformation must be defined in order to maintain an optimal balance between technological innovation and the preservation of the essential values of education.

ARACIS clarifies that *“distance learning, also known as distance education, E-learning, or online learning, is characterized by the physical separation of teachers and students in the learning process and the use of diverse technologies to facilitate student-teacher and student-student communication”* (ARACIS, 2020). A distance learning program can be

organized either exclusively online or in a blended learning model, which combines distance learning activities with face-to-face meetings (in the classroom).

The training process, which includes teaching, learning, and assessment, can be conducted remotely. It can take place in a synchronous format, where students and teachers interact at the same time from different locations. Alternatively, it can be conducted in an asynchronous format, where teaching activities do not occur simultaneously. In this case, educational content is provided as study resources that students can access later. These activities are carried out using digital devices (laptops, mobile phones, tablets, etc.) connected to the Internet.

A specialist in the field defines distance learning as “*a planned teaching-learning experience organized by an institution that provides materials in a sequential and logical order to be assimilated by students in their own way, without constraining the agents of the activity to co-presence or synchronicity*” (Istrate, 2000).

In a succinct phrase, “*E-learning is a type of distance education with a planned teaching-learning experience organized by an institution that provides online materials arranged in a logical, sequential manner to facilitate assimilation by each learner in their own way*” (Mitan, 2017).

The reasoned decision to choose distance learning as an effective alternative to face-to-face programs depends essentially on a detailed analysis of socio-cultural, legal, economic, and geopolitical factors external to educational institutions, in order to assess their impact on the demand for educational programs and to adapt the offer in accordance with the institution’s mission and vision (Codreanu & Vasilescu, 2024).

As digital technologies increasingly influence various sectors of society, “*there is an expectation of substantial changes to*

*the way teaching and learning takes place*” (OECD, 2025). Having in mind this statement from the OECD, correlated with the affirmation of a renowned Japanese specialist, who predicts that the role of teachers in the learning process of students will remain important, but the way teachers and students interact has begun to change (Kang, 2021), I consider that no matter how intense the resistance to traditional teaching and learning methods may be, change is on the way, with profound effects.

The Digital Education Action Plan (2021-2027) sets out two strategic priorities and a series of actions to support them (European Commission, 2021):

➤ **Priority 1** aims *to develop a high-performing digital education ecosystem* through actions such as structured dialogue with Member States, recommendations for blended learning, ensuring connectivity and digital equipment, and ethical guidelines on the use of artificial intelligence in education;

➤ **Priority 2** focuses on *developing digital skills and competences relevant for the digital transformation*, through guidance for teachers, updating the *European Digital Competence Framework*, certifying digital competences, promoting women’s participation in STEM (science, technology, engineering, and maths) fields, collecting EU-wide data to monitor progress, etc.

One of the robust arguments put forward by Bărbieru in support of E-learning is that it “*offers the possibility of educating a wide range of people at low cost*” (Bărbieru, 2017). E-learning is a form of training that provides educational and training opportunities and is currently used in most universities as a complement to traditional education. This method is based on hardware and software technologies developed in parallel with the evolution of society (Bărbieru, 2015).

### 1.1. Scientific Research Methodology

The article uses a mixed methodological design (qualitative-quantitative), designed to analyse the digital transformation of military education within NATO through the implementation of E-learning solutions, with a focus on the ADDIE and LWA pedagogical models. The approach was based on the integration of conceptual analysis with empirical evaluation, in order to obtain a systemic perspective on the phenomenon.

### 1.2. The Main Objectives

- Characterization of pedagogical models used in military E-learning;
- Evaluating the effectiveness of these models in relation to training objectives.

The research adopted a descriptive-analytical strategy, integrating documentary analysis of the NATO's regulatory and

strategic framework, as well as of the pedagogical models implemented, such as a case study on the impact of the LWA model within the NATO quality assurance course.

## 2. Analysis of E-learning within NATO Structures

In the context of rapid technological developments and the need to keep armed forces ready for contemporary challenges, NATO has initiated a series of measures to bring new digital solutions to military education. The digital transformation of military education involves integrating digital technologies to optimize educational and operational processes. A helpful framework for understanding and adapting these processes is the OODA loop, which includes four essential stages: observation, orientation, decision, and action, accompanied by a continuous feedback loop (Figure no. 1).

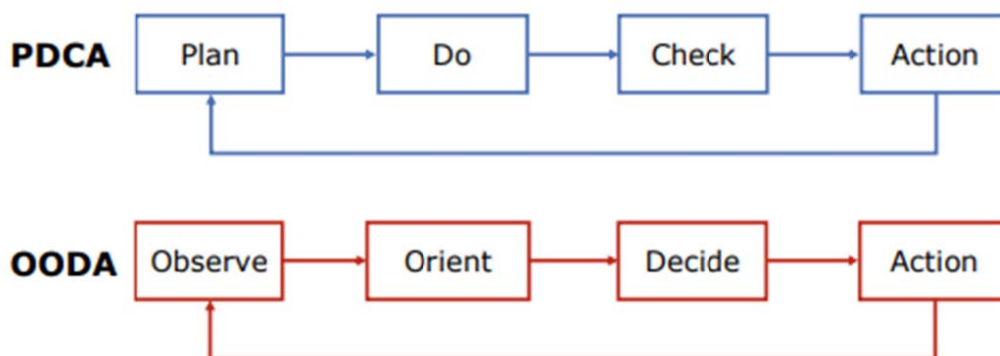


Figure no. 1: The PDCA cycle and the OODA loop  
(Source: Kang, 2021)

This methodology is similar to the PDCA cycle (plan, do, check, act), which is frequently used in process management. Although the PDCA cycle reveals differences between assumptions and actual conditions, it does not fully encompass the practical aspects that extend beyond those assumptions. In contrast, the OODA loop does not have such limitations and is more effective in adapting to real-life situations (Kang, 2021).

The E-learning models developed to date, based on those in the education system, are (Mitan, 2017):

- *The self-directed model* is aimed at experienced learners and provides access to online materials without a tutor or communication between learners, with changes recorded in a database;

- *The facilitated model* adds tools such as email and forums, and the administrator ensures access to information and support;

➤ *The advanced model* includes technologies for real-time communication (video conferencing, chat, whiteboard) and has a tutor and administrator who monitor the educational process.

A notable example is the launch of the first *Defence Education Enhancement Programme (DEEP) Strategy for Distance Learning Support (2021)*. This strategy aims to provide military education institutions and instructors in allied and partner countries with the digital competences necessary to effectively use the methods and tools required by the new learning system imposed by the pandemic (NATO, 2021). This document was published shortly after the outbreak of the global COVID-19 pandemic. Marc Di Paolo, Director of Defense Institution and Capacity Building at NATO HQ, emphasized on the strategy's opening page that "*online learning, hybrid curricula, micro-learning, metaverse based social learning environments for geographically separated students [...] these are just a few forms of distance learning support which could be harnessed to improve pedagogy and learning outcomes*" (Solis et al., 2021).

The strategy is intended to ensure future support for e-learning. This strategy targets five specific areas (Solis et al., 2021):

- Institutional Support (organizing and managing an educational institution);
- Curriculum Development (content to be provided);
- Teacher Training (teaching methods);
- ADL Technology Support (the technological tools necessary for a virtual classroom);
- English Language Training (English language teaching and learning).

The adoption of E-learning in military education allows for the continuous training of military personnel, in any location. This is particularly important in the context of operations in war zones or international

missions. Among the advantages of using E-learning in NATO are:

➤ *Flexibility of learning* – military personnel can access educational resources anytime, anywhere, eliminating dependence on traditional classroom training;

➤ *Cost efficiency* – reduction of transportation, accommodation, and logistics costs associated with conventional training;

➤ *Personalization of the learning process* – modern E-learning platforms offer the possibility to adapt educational content to the needs of each learner;

➤ *Simulations and virtual reality* – these technologies provide realistic and interactive training, allowing participants to practice tactical scenarios and unpredictable situations without real risks.

The NATO E-learning Program is conforms to STANAG 2591, elaborated by the NATO Standardization Agency and requires, as an interoperability requirement, the existence of a procedure for the development of content and online education and training courses for NATO education and training facilities and similar facilities in NATO countries and partner countries (STANAG 2591, 2013).

In this context, the NATO Defense College (NDC) has adopted advanced learning methods, combining Advanced Distributed Learning (ADL) courses and blended learning. The NDC's academic portal provides a learning management system that offers educators, administrators, and learners a unique, robust, secure, and integrated system to create customized learning environments (NATO Defense College, 2025). This portal offers courses such as "*Introduction to NATO*", "*Introduction to Common Security Defense Policy*" and "*International Relations Refresher*" designed to prepare learners for national or international responsibilities in the field of security.

ADL/E-learning solutions will also need to take into account the availability of

students in different time zones, as well as potential maintenance interruptions that may block access to the online learning management system - LMS (NATO, 2015).

Another example of E-learning integration is NATO Joint Advanced Distributed Learning - JADL (NATO E-learning, 2025), a platform that provides online courses for allied forces, allowing personnel to access training materials in a flexible manner tailored to their individual schedules. This platform integrates modern learning management system functionalities, ensuring a coherent and effective educational experience.

The Romanian Army is currently in the process of approving the Strategy for the *Digital Transformation of the Romanian Army for the period 2025-2029*. The Report on the activities carried out by the Ministry of National Defense in 2024, in the chapter on “digitization” mentioned: “the operationalization of the NATO Software Tools package and Romania’s participation in projects for cooperation in the development and implementation of software, in an allied format, are other actions carried out to accelerate digital transformation at the ministry level” (Official Gazette of Romania, 2025).

Although the digital transformation of NATO military education through E-learning offers numerous advantages, it also comes with a number of challenges:

➤ *cybersecurity* – the necessity to protect sensitive information and digital infrastructure from cyberattacks;

➤ *accessibility and interoperability* – ensuring uniform access to E-learning resources for all NATO member states, regardless of the technological infrastructure available;

➤ *resistance to change* – some institutions and teachers may be reticent to adopt new technologies, requiring an effective implementation and training strategy.

Despite these challenges, the future of military education in NATO is linked to digital transformation. The integration of E-learning solutions, the use of artificial intelligence, and the development of advanced simulation environments will contribute to increasing the effectiveness of armed forces training. NATO continues to invest in innovative educational technologies, thus ensuring a high level of preparedness for future global security challenges.

The digital transformation of military education in NATO through E-learning builds on lessons learned and makes recommendations on how to make online defense education and training more effective, less costly, more versatile, and more student-centered, even after COVID-19.

### **3. NATO Models for the Development of E-learning**

The implementation of E-learning within NATO structures has evolved significantly, reflecting the Alliance’s commitment to modernizing and streamlining military training and education processes. This digital transformation has been achieved through the adoption of advanced pedagogical models and technologies tailored to the specific needs of NATO’s military and civilian personnel.

#### **3.1. The ADDIE Model (Analysis, Design, Development, Implementation, and Evaluation)**

*The NATO advanced distributed learning handbook: Guidelines for the development, implementation and evaluation of Technology Enhanced Learning* is a manual that supports NATO and partner countries in producing effective ADL content for specific or common training and education needs (NATO Training Group, 2023). The model used by NATO for E-learning development is the ADDIE model.

ADDIE is a commonly used process for designing, implementing, and evaluating training materials. Although the

model presents the stages in a clear sequence, in reality they can be carried out simultaneously (NATO Training Group,

2023). The ADDIE model is illustrated in Figure no. 2.

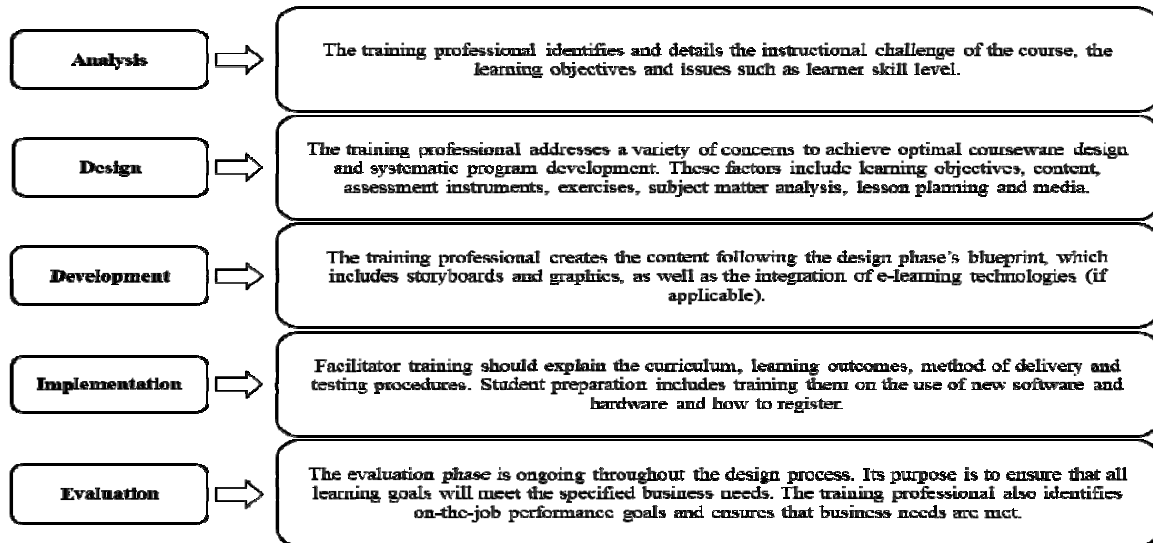


Figure no. 2: *The ADDIE model for developing training materials*  
(Source: Training Industry, 2025)

The process of planning and executing exercises follows six steps: *strategic orientation, design, preparation, execution, evaluation, and analysis*. This cycle has a structure comparable to the ADDIE model – analysis, design, development, implementation, and

evaluation – the two being complementary processes. Each stage in the exercise cycle is guided by specific factors that directly influence the next phase. The ADDIE model can effectively support each of these stages, as shown in Figure no. 3.



Figure no. 3: *Considerations regarding the planning and execution cycle*  
(Source: NATO Training Group, 2023)

The six-step exercise planning and conduct process was developed in accordance with *NATO Bi-SC CT-ED 75-3* for use in large-scale distributed multinational exercises. The ADDIE model, used for the development of eLearning content, is presented in detail in the *NATO Advanced Distributed Learning Manual* (2019). Each of the six stages of the planning and execution cycle is defined by specific factors and considerations that directly influence the next stage (Figure no. 3).

According to information provided by NATO Allied Command Transformation, the team responsible for E-learning is constantly exploring new technologies and effective solutions to continuously improve education and training within the Alliance (Allied Command Transformation, 2025). ADDIE is also called the *NATO Systems Approach to Training (SAT)* or *Instructional Systems Design (ISD)*.

Some benefits of ADDIE (TRADOC, 2025):

- cost-effective*: provides clearly defined learning objectives, structured and coherent content, and appropriate activities and assessments for learners, linked to the intended learning outcomes, which increases the chances of success rather than failure;

- relevant*: provides the necessary information without unnecessary details, creating a more concise message;

- customizable*: focuses on the needs of the target audience;

- flexible*: delivery methods provide anytime, anywhere access for learners;

- adaptable*: encourages evaluation at every step and promotes quality assurance and redesign at every stage.

### 3.2. The LWA Model (Learn-Watch-Ask)

This is an innovative model tested by NATO, which integrates digital tools with traditional teaching methods, creating a learning experience tailored to the needs of learners. They need educational tools that are flexible, engaging, and efficient. In this context, the LWA training model is designed to improve interaction and understanding in the learning process (Bălănescu, 2023).

As illustrated in Figure no. 4, the LWA model consists of three interdependent components: a structured online course (Learn), a specialized YouTube channel for visual understanding (Watch), and an AI chatbot for interactive learning (Ask).

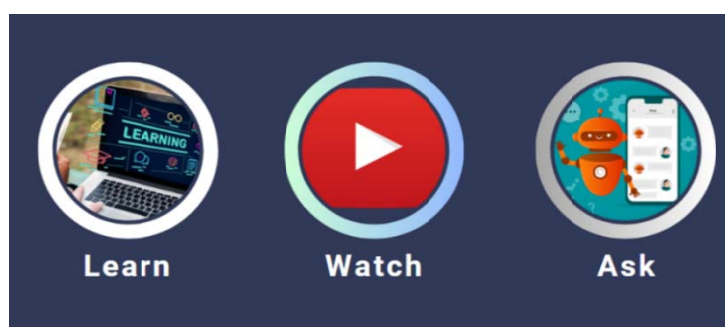


Figure no. 4: The “Learn-Watch-Ask” model  
(Source: NATO QA HUB, 2025)

*Learn* is represented by a structured online course designed to provide fundamental knowledge and prepare learners to explore more advanced concepts.

*Watch* refers to a series of interactive videos available on a dedicated YouTube channel that facilitate understanding and visualization of complex aspects of the quality assurance process.

*Ask* involves the use of an artificial intelligence-based chatbot, created to support the continuous learning process, offering learners the opportunity to ask questions and receive immediate answers and clarifications, thus contributing to the permanent consolidation of the knowledge acquired.

This multimodal approach supports diverse learning styles, providing increased accessibility and efficiency.

A case study on the application of the Learn-Watch-Ask model in the NATO

course on quality assurance in individual education and training (S7-137) was conducted to assess its potential as an alternative to traditional training methods, which have proven to be limiting in terms of knowledge retention and learner engagement.

The analysis was performed on a sample of 200 students distributed pre-LWA (110 students) and post-LWA (90 students). The data collected and analyzed are shown in the Table below.

**Table no. 1**

*Set of data with average grades at the end of the exam*

Iteration	No. of students/ iteration	Mean final exam score (%)	Iteration type/Final exam score difference
January 2021	28	65.2	Pre-LWA (Start)
November 2021	26	68.4	Pre-LWA (+3.2%)
January 2022	27	66.1	Pre-LWA (-2.3%)
November 2022	29	67.3	Pre-LWA (+1.2%)
January 2023	30	78.5	Post-LWA (+11.2%)
March 2023	26	80.2	Post-LWA (+1.7%)
November 2023	28	82.1	Post-LWA (+1.9%)
January 2024	25	83.9	Post-LWA (+1.8%)

(Source: Bălănescu & Oswald, 2024)

The period analyzed in the study was between January 2021 and November 2024. The results conclusively indicated that the implementation of the LWA model leads to

significant improvements in learning performance in the context of NATO training in the field of quality assurance (Figure no. 5).

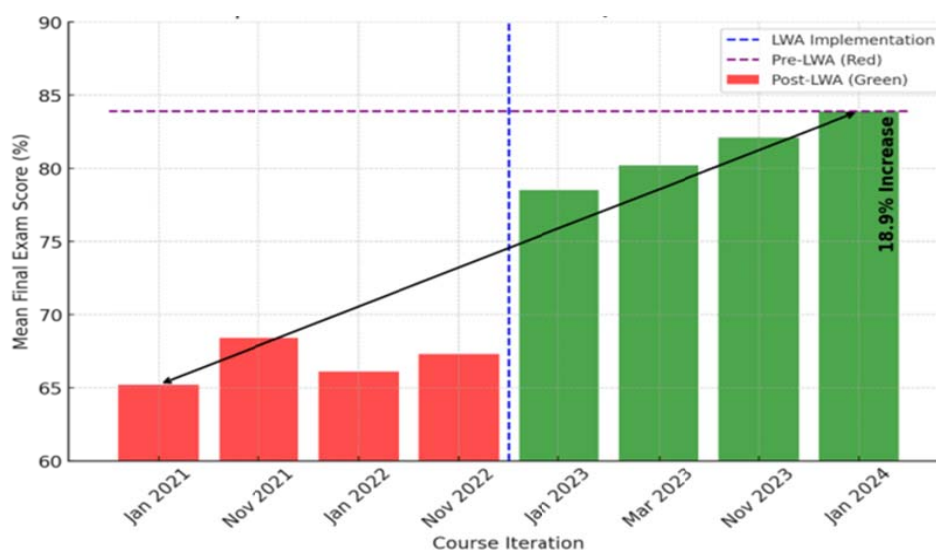


Figure no. 5: *Impact of the LWA model on NATO QA course results*  
(Source: Bălănescu & Oswald, 2024)

With an 18.9% increase in retention rates, the LWA model highlights its potential as an effective and scalable training methodology applicable in the military domain, academia, and corporate organizations, a conclusion supported by the military experts who realized the study.

The author of the scientific research presents the advantages of the LWA training model (Bălănescu, 2023):

- *accessibility*: provides continuous access regardless of location, time zone, or type of device used (phone, tablet, laptop);

- *flexibility*: provides control over time planning, access to content, and the ability to revisit materials whenever necessary;

- *permanent assistance*: the existence of an AI-based chatbot that provides round-the-clock support for learners;

- *multimodal learning*: leverages the integration of text, video, and interactive elements to cater to diverse learning styles;

- *cost efficiency*: demonstrates that high-quality education does not have to be expensive;

- *integration of components*: using the model does not require technical knowledge on the part of instructors, thus facilitating a continuous, fluid, and intuitive learning experience;

- *security*: advanced cybersecurity standards are followed, ensuring data protection and the educational process.

A comparative analysis of the results obtained in this article with those reported in the literature reveals both the strengths and limitations of the models analyzed. Similar to the opinions of Solis et al. (2021) and the *NATO Training Group* model (2023), the implementation of the ADDIE model proves to be extremely effective in ensuring structural coherence and pedagogical consistency. However, its sequential nature may limit adaptability in rapidly evolving operational environments.

In contrast, the LWA model, in line with the solutions proposed by Bălănescu

and Oswald (2024), demonstrates superior flexibility and increased learner engagement through multimodal interaction, but remains dependent on the availability of robust digital infrastructure and advanced user skills.

These results confirm trends identified in previous NATO and academic research, illustrating that while technology-enhanced learning can increase efficiency and accessibility, the integration of digital tools must always be balanced with pedagogical rigor and institutional readiness. Thus, both models should be considered complementary rather than mutually exclusive solutions, each addressing distinct dimensions of instructional design in the military context.

#### 4. Conclusions

The digital transformation of military education within NATO is a long process, driven both by technological advances and the need to adapt to the challenges of the contemporary operational environment. The integration of E-learning solutions, particularly through the ADDIE and LWA models, demonstrates the considerable potential of digital technologies to increase the efficiency, accessibility, and flexibility of the training process. Online platforms allow learners to access educational materials from anywhere and at any time, thus facilitating a continuous learning process tailored to individual schedules.

However, implementing E-learning within NATO structures is not without challenges. Ensuring the cybersecurity of training platforms, adapting content to different cultures and languages, keeping educational content up to date, and guaranteeing interoperability between the various systems used by member states are just some of the key issues that require constant effort.

Each nation has its own approach to education and training. While some countries emphasize hierarchical structures

and rigorous disciplines, others promote more flexible and interactive methods. NATO E-learning must be adaptable enough to allow each country to customize content to its needs without compromising overall interoperability goals.

In order to fully exploit the potential of military eLearning, it is necessary to develop a coherent methodology that combines technological innovation with the maintenance of pedagogical standards and the fundamental values of military education. In this regard, it is recommended to strengthen cooperation between NATO member states, continue investing in digital infrastructure and staff training, and integrate emerging solutions such as artificial intelligence and advanced simulation environments into training programs.

A detailed evaluation of the research results reveals a measurable impact of E-learning adoption on the professional development of military leaders. Based on the

empirical data collected, the implementation of the LWA model generated an average improvement of 18.9% in knowledge retention and course completion rates, confirming its effectiveness in improving learning outcomes. Furthermore, both the ADDIE and LWA frameworks contribute to optimizing training time, resource allocation, and cost-effectiveness, supporting a data-driven approach to leadership education.

From an operational perspective, these results indicate that the integration of digital learning solutions enhances decision-making agility, situational awareness, and adaptability among military leaders, enabling continuous professional development aligned with NATO's transformation goals. Consequently, the calculated impact of the models demonstrates that eLearning is not only a pedagogical alternative but also a major factor in the modernization of military education systems.

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