Impact of New Technologies on Military Academic Education

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Abstract

New technologies have revolutionized the way military academic institutions approach education and training. They can provide a wide range of education tools that can enhance the learning experience for military cadets. For example, educational software can be used to create interactive simulations, games, and quizzes that engage cadets and help them to learn in a more enjoyable and effective way. Online learning platforms and videoconferencing tools can also be used to provide distance education, making it possible for cadets to access educational resources and connect with teachers and other cadets from anywhere in the world. Furthermore, new technologies such as virtual and augmented reality can provide immersive learning experiences that allow cadets to interact with digital content in a more hands-on way, such as they can replicate complex, dynamic environments and allow them to train in a safe, controlled environment, reducing the risk of injury and equipment damage.

This study provides an investigation of using a new technology for improving military academic education including some tools that provide realistic and immersive training experiences, in which they can prepare cadet for real-world scenarios. This type of training has been compared to traditional training methods including challenges and opportunities. This paper has demonstrated that these new technologies have significantly impact the military academic education level.

Keywords: New technology, academic military education, cadet, artificial intelligence (AI), virtual reality (VR), augmented reality (AR).

تأثير التقنيات الجديدة على التعليم العسكري الأكاديمي

الملخص:

لقد أحدثت التقنيات الجديدة ثورة في الطريقة التي تتعامل بها المؤسسات الأكاديمية العسكرية مع التعليم والتدريب. ويمكنها توفير مجموعة واسعة من أدوات التعليم التي يمكن أن تعزز تجربة التعلم للطلاب العسكريين. على سبيل المثال، يمكن استخدام البرامج التعليمية لإنشاء محاكاة تفاعلية وألعاب واختبارات تشرك الطلاب وتساعدهم على التعلم بطريقة أكثر متعة وفعالية. كما يمكن استخدام منصات التعلم عبر الإنترنت وأدوات مؤتمرات عبر الفيديو لتوفير التعليم عن بعد، مما يجعل من الممكن للطلاب الوصول إلى المصادر التعليمية والتواصل مع المعلمين والمدرسين والطلاب الآخرين من أي مكان في العالم. وعلاوة على ذلك، يمكن للتقنيات الجديدة مثل الواقع الافتراضي والمعزز أن توفر تجارب تعليمية معززة للواقع الافتراضي تسمح للطلاب بالتفاعل مع المحتوى الرقمي بطريقة أكثر عملية، مثل إمكانية تكرار البيئات المعقدة والديناميكية والسماح لهم بالتدريب في بيئة آمنة وخاضعة للرقابة، مما يقلل من خطر الإصابة وتلف المعدات.

تقدم هذه الدراسة تحقيقًا في استخدام تقنيات جديدة لتحسين التعليم الأكاديمي العسكري بما في ذلك بعض الأدوات التي توفر تجارب تدريبية واقعية وغامرة او معززة للواقع الافتراضي، حيث يمكنها إعداد الطلاب لسيناريوهات العالم الحقيقي. وقد تمت مقارنة هذا النوع من التدريب بأساليب التدريب التقليدية بما في ذلك التحديات والفرص. وقد أظهرت هذه الورقة أن هذه التقنيات الجديدة كان لها تأثير كبير على مستوى التعليم الأكاديمي العسكري.

الكلمات المفتاحية: التكنولوجيا الجديدة، التعليم العسكري الأكاديمي، الطلاب العسكريون، الذكاء الاصطناعي، الواقع الافتراضي، الواقع المعزز.

I. Introduction

In the recent years, there has been a growing reliance on new technologies in various aspects of society, including education. New technologies have had a big impact on military academic training. The educational experience for both teachers and cadets has improved thanks to the revolutionary changes brought about by new technology in teaching and learning. Cadet is an individual who is undergoing training to become commissioned officer in the military, that typically enrolled in a military academy.

One of the key impacts of new technologies on military academic education is the introduction and utilization of instructional media. Instructional media, such as e-media and online platforms, have provided cadet with enhanced access to educational resources. These resources include online textbooks, multimedia presentations, and interactive simulations that contribute to a more engaging and dynamic learning environment (Moreno-Guerrero et al. , 2020). The field of education has been greatly influenced by the rapid advancements in technology. Information and communication technologies have had a particularly strong impact on teaching and learning processes, leading to the emergence of new training perspectives and promoting techno-pedagogical practices (Moreno-Guerrero et al., 2020).

The integration of new educational technologies in military education has shown positive effects on knowledge acquisition, analysis, and contextualization for both instructors and cadets. The authors (Çimşir & Uzunboylu, ٢٠١٩) suggest that the use of technology in military education increases productivity, reduces costs, and increases the demand for academic programs. Various instructional methods and curriculum reforms based on instructional media and technology have been introduced in military education, contributing to improved learning experiences and classroom environments. These advancements have allowed for the integration of information technology with education, attracting student attention and making them more active participants in the learning process. Technology-enhanced classrooms in military education have proven to be effective in improving learning outcomes. In language education, classrooms that use technology have been shown to produce positive results (Kassim, 2021).

The military is an institution that constantly evolves to adapt to changing technological landscapes and geopolitical realities. In the field of military education, the incorporation of new technologies has become crucial in order to modernize training methods and keep up with advancements in warfare tactics and technologies. The use of technology in military education has brought about significant improvements in the delivery and effectiveness of training programs. For example, the use of virtual reality and augmented reality technologies in military training allows for realistic simulations of combat scenarios.

These immersive technologies provide soldiers with valuable hands-on experience in a safe and controlled environment, helping them develop critical skills and decision-making abilities. Additionally, the integration of mobile devices such as tablets and smartphones in military education has also proven to be beneficial (Chen, 2020b), (Boyce et al., 2022).

Artificial intelligence (AI) (Russell, 2010) and machine learning (ML) (Alpaydin, 2020) technologies are being used to develop intelligent tutoring systems that provide personalized learning experiences for cadet. These systems can adapt to individual learning styles and provide real-time feedback, improving learning outcomes. In addition, cybersecurity education and training are becoming increasingly important in military academic education, as the threat of cyber-attacks continues to grow, such training can be also achieved by simulation.

Therefore, new technologies have provided military academic institutions with new tools and techniques to enhance learning and training. By leveraging these technologies, cadet can be better prepared for the challenges of modern warfare, improving operational effectiveness and readiness.

The organisation of this paper is as follows: Section 2 will introduce related surveys, while Section 3 will present new technologies. Section 4 will focus on challenges and effects, and Section 5 will be discussion and evaluation. Finally, the paper will conclude.

II. Related Surveys

In this section I will present some related works. They introduce how the new technologies have had a significant impact on military academic education, providing new opportunities for learning and training. The report (Balboni et al., 2020) by the US Army War College discuss the effects of new technologies on military academic education and emphasized on the need for military academic education to adapt to new technologies and incorporate them into the curriculum. The report stated that technology is changing the way we learn, and military education must adapt to remain relevant and effective.

Smolik (2021) in the Journal of Military and Strategic Studies highlighted the potential of virtual reality (VR) and augmented reality (AR) technologies for military education and training. The article stated that VR and AR technologies can provide realistic and immersive training experiences that enhance learning and improve operational effectiveness.

Schatz et al. (2015) emphasized the need for military academic education to incorporate new technologies, such as artificial intelligence and machine learning, into the curriculum. The authors stated that military education must provide the skills and knowledge

necessary to leverage emerging technologies in the field. In reference (Al-Shehri, 2022), it has been highlighted the potential of simulation and modeling technologies for military education and training. The article stated that simulation and modeling can provide realistic and cost-effective training experiences that prepare cadet for real-world scenarios.

Therefore, these references demonstrate that new technologies are having a significant impact on military academic education, providing new opportunities for learning and training. By embody new technologies such as VR, AR, simulation and modeling, and artificial intelligence into the curriculum, military academic institutions can better prepare military cadets for the challenges of modern warfare.

The main contribution of this paper is to highlight new technologies and their effects on military academic education. In addition, presented the most recent challenges and proposed practical approaches to tickle them.

III. New Technologies

There are several emerging technologies that can leverage the military education performance. To the best of my knowledge, I will focus on most Six technologies that can provide such enhancement. First, online learning platforms, these platforms have become increasingly popular in recent years, particularly in the wake of the COVID-19 pandemic. They offer a wide range of courses and resources for learners of all ages and backgrounds. Some popular examples include Coursera (Coursera), edX (edX) , and Udemy (Udemy).

Second, educational software; provides interactive simulations, games, and quizzes to engage cadets and help them learn in a more enjoyable and effective way. Examples include Quizlet (Quizlet) and Kahoot (Kahoot).

Third, virtual reality (VR) and augmented reality (AR); these technologies provide immersive learning experiences that allow cadets to interact with digital content in a more hands-on way. Examples include Google Expeditions (Culture) and Nearpod VR (VR), more explanation will be provided in the next coming two sections.

Fourth, videoconferencing tools; these allow cadets to connect with teachers and other cadets remotely, making distance education possible. Examples include Zoom (Zoom) and Microsoft Teams (Teams).

Fifth, Artificial intelligence (AI) and machine learning (ML); these technologies can be used to personalize learning experiences and provide adaptive feedback to cadets. Examples include Smart Sparrow (Sparrow) and Carnegie Learning (Learning).

Sixth, 3D printing; this technology can be used to create physical models that help cadets

visualize complex concepts in subjects like science and engineering. Examples include MakerBot (Bot) and Ultimaker (Ulti-Maker).

They are particularly useful for training in hazardous environments, such as chemical and biological warfare, where hands-on training may not be feasible. Virtual and augmented reality technologies provide realistic training experiences that enhance learning and improve operational effectiveness. Virtual reality allows personnel, especially cadets, to train in simulated environments that replicate real-world scenarios, while augmented reality overlays digital information onto the real world, providing personnel with additional information and context.

IV. Challenges and Effects

Implementing comprehensive training programs for military leaders can present several challenges There are some challenges military academic institutions face when comprising new technologies into their curriculum. Incorporating new technologies into the curriculum of military academic institutions can present several challenges. I can be summarized some of the them that military academic institutions may face, as follow:

1. Resource Constraints: Incorporating new technologies into the curriculum can be resource-intensive, requiring significant investments in time, money, and personnel. Military academic institutions may face challenges in obtaining the necessary resources to develop and implement these programs.

2. Technological Complexity: Many new technologies are complex and require specialized training to use effectively. Military academic institutions may need to invest in training programs that are tailored to specific technologies and systems.

3. Resistance to Change: Incorporating new technologies into the curriculum may require changes to organizational culture and processes, which can be met with resistance from faculty and cadets who are accustomed to the status quo. Military academic institutions may need to address resistance to change in order to successfully incorporate new technologies into the curriculum.

4. Security Risks: Many new technologies, such as those related to cybersecurity or artificial intelligence, present security risks that must be carefully managed. Military academic institutions may need to develop policies and procedures to ensure that sensitive information is protected.

5. Integration with Existing Curriculum: Incorporating new technologies into the curriculum must be done in a way that integrates with existing courses and programs. Military academic institutions may need to carefully plan the integration of new technologies to

ensure that they complement rather than disrupt existing curriculum.

6. Skills Gaps: Not all cadet may possess the necessary skills to effectively use new technologies and systems. Military leaders may need to identify skills gaps and develop targeted training programs to address these gaps.

Therefore, comprising new technologies into the curriculum of military academic institutions can present several challenges. The data synthesis is the methodology of this paper. It is based on combine the findings from the various past research studies that I have collected data from, including references in literature review section. This involves identifying common themes, contrasting results, or meta-analysis in which the statistical techniques for combining quantitative data from multiple studies. The results will be more elaborated and explained in the next section, discussion and evaluation. Military academic institutions must be proactive in addressing these challenges and developing training programs that are effective, efficient, and tailored to the needs of their organisations. To overcome these challenges, military leaders need to have computer education to effectively lead their organisations in a technology-driven world. There are several institutions provide their evidence for this point of view. They can be found in digital literacy is essential for military leaders to execute multi-domain operations (Schatz et al., 2015), (Feickert, 2018). Military officers must have a fundamental understanding of computer science to effectively operate in a technology-driven world (Dede & Richards, 2020). Furthermore, cybersecurity education for military leaders is essential to protect national security interests (Spidalieri & McArdle, 2016). Thus, computer science education is essential for modern military operations, and military leaders must be equipped with the skills to effectively leverage technology in the field (Defense, 2021).

As a result, I have demonstrated that military leaders need to have computer education to effectively lead their organisations in a technology-driven world. By possessing digital literacy, a basic understanding of computer science, and cybersecurity education, military leaders can effectively leverage technology to enhance situational awareness, improve operational efficiency, support cybersecurity operations, and foster innovation in their organisations (Defense, 2021).

On the other hands, these technologies have their own effects on military academic education. New technologies have had a transformative impact on military academic education, providing new opportunities for learning and training. I will highlight some of the ways that new technologies have affected military academic education. The online learning platforms has made it easier than ever for cadet to pursue advanced degrees and professional development opportunities. Online learning platforms offer flexible scheduling and remote access to coursework, allowing cadet to learn anytime, anywhere.

Moreover, simulation and Modeling: Simulation and modeling technologies provide realistic and immersive training experiences that prepare cadet for real-world scenarios. These technologies allow personnel to train for a wide range of scenarios in a safe and controlled environment, reducing the risk of injury and equipment damage. Obviously, virtual and augmented reality technologies provide realistic and immersive training experiences that enhance learning and improve operational effectiveness. These technologies are particularly useful for training in complex or hazardous environments where hands-on training may not be feasible. Recently, artificial intelligence and machine learning technologies are being used to develop intelligent tutoring systems that provide personalized learning experiences for cadet. These systems can adapt to individual learning styles and provide real-time feedback, improving learning outcomes.

None of the above can achieve their goal without cybersecurity. Cybersecurity education and training are becoming increasingly important in military academic education, as the threat of cyber-attacks continues to grow. Military academic institutions are including cybersecurity education into their curricula to ensure that personnel are prepared to protect sensitive information and networks. Therefore, new technologies have had a transformative impact on military academic education, providing new opportunities for learning and training. By leveraging these technologies, military academic institutions can better prepare cadets for the challenges of modern warfare, improving operational effectiveness and readiness.

V. Discussion and Evaluation

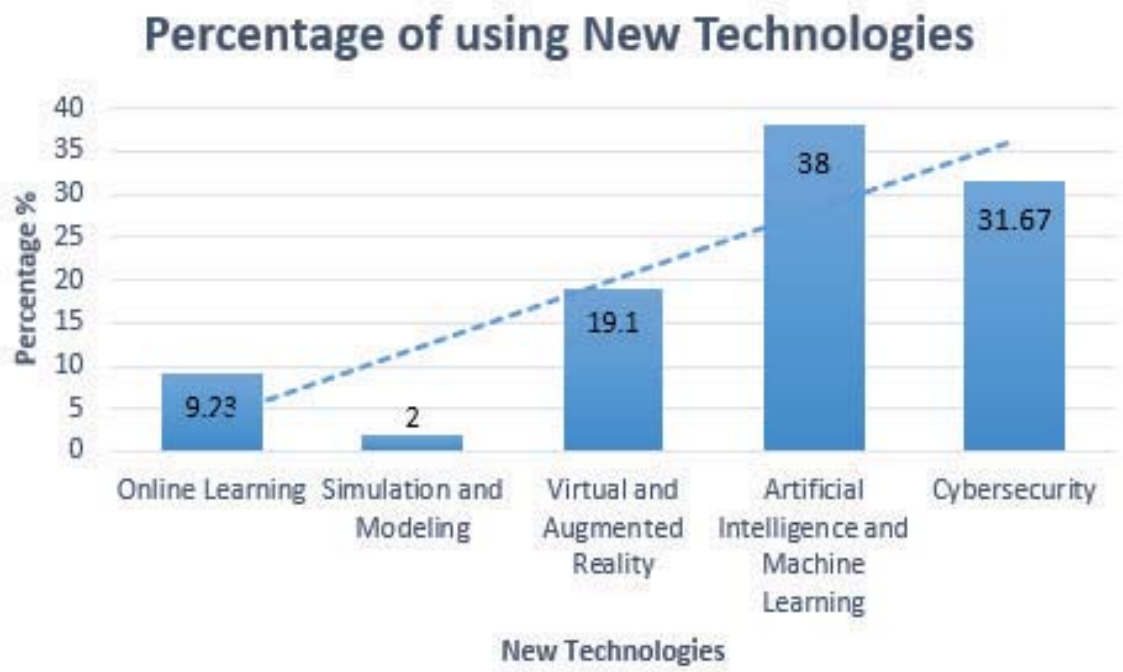
Military academic education is an important aspect of training and preparing military leaders to operate in a complex and ever-changing international environment. In light of the current international environment, there are several key considerations that military education programs should take into account. One of the most important considerations is the changing nature of warfare. Modern conflicts are often characterized by a combination of traditional and asymmetric warfare, which requires military leaders to be well-versed in a range of tactics and strategies. Military education programs should therefore prioritize the development of leaders who are adaptable, innovative, and able to think critically in complex and uncertain situations (Sheringham, 2022).

Another key consideration is the need for military leaders to have a deep understanding of the political, economic, and social factors that shape conflicts around the world. Military education programs should emphasize the importance of developing a nuanced understanding of the cultural and historical contexts in which conflicts arise, as well as the role that non-military actors such as NGOs, international organisations, and private sector entities play in shaping the international environment.

In addition, military education programs should focus on developing leaders who are proficient in the use of new technologies and who are able to leverage emerging capabilities to gain a tactical advantage on the battlefield. This includes not only technological developments in areas such as cyber warfare and unmanned systems, but also the use of big data and analytics to inform decision-making and improve operational effectiveness.

There are statistics on the use of emerging technologies 2021, as shown in Fig.1. Online learning has been growing steadily in recent years 9.2% and is expected to continue to grow in the future. Simulation and modeling tools are widely used in higher education and research settings 2%, still relatively limited compared to other technologies. While virtual and augmented reality technologies are still relatively new with 19.1%, however, they are gaining popularity within the trending dotted line, as illustrated in Fig.1. Artificial intelligence and machine learning are extremely increasingly being used in education with 38%. It has been exceeding the expectation. Cybersecurity is becoming increasingly important in education with 31.67%, but it is difficult to estimate the percentage of institutions that use cybersecurity technologies specifically for education.

Fig.1 Uses of new technologies in education



In general, the usage of these technologies in education varies depending on factors such as the institution, location, and age group of cadets.

Military education is constantly evolving, and the impact of new technologies is likely multifaceted and depends on the specific technology, educational institution, and branch of the military.

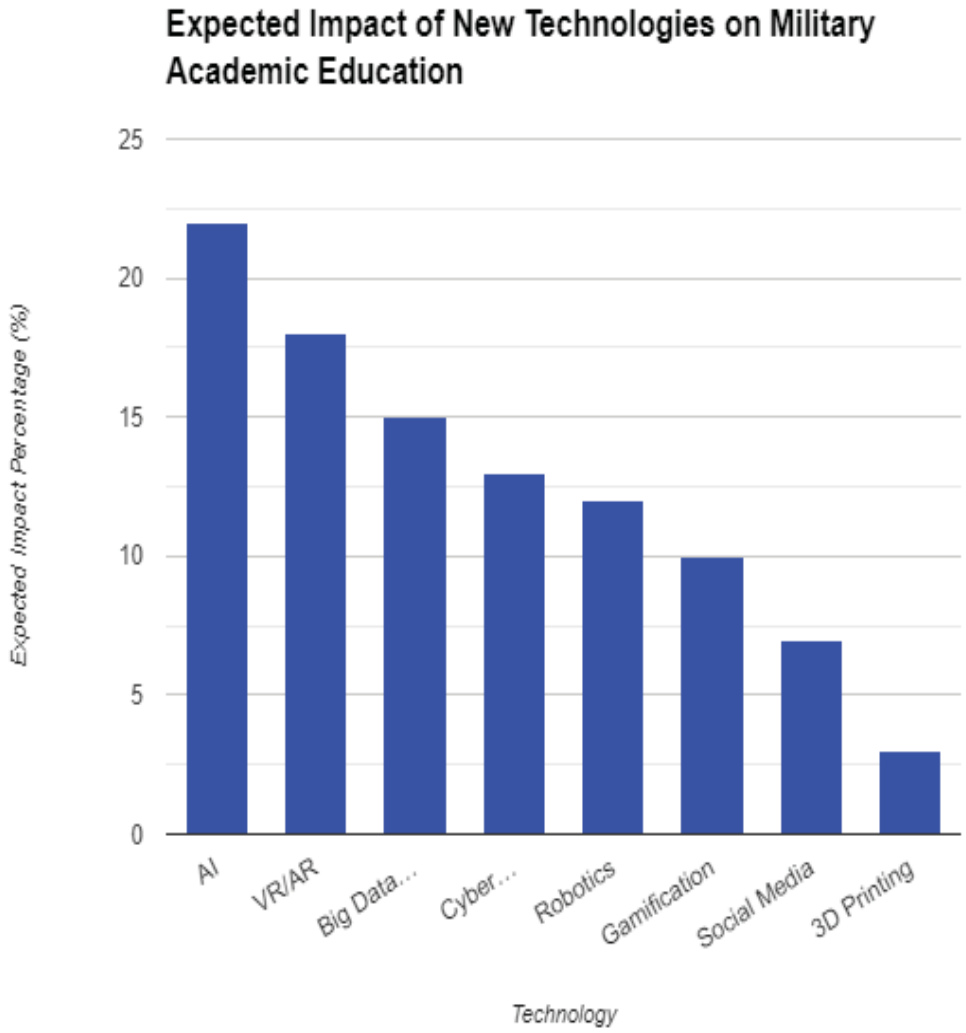
However, based on the resources I have provided along with general education trends, here is how a hypothetical of the impact of new technologies on military academic education could be interpreted as follow. Fig.2 shows that it should be noted that the following interpretation based on what has been presented is provided on a purely hypothetical basis:

Where: X-axis: represent the different new technologies used in military education (e.g., Simulation & VR, E-learning, Big Data).

Whereas: Y-axis: represent the perceived impact of the technology on a scale (e.g., 1= Minimal Impact, 25= High Impact).

In this section I will present the Hypothetical breakdown aspects. Firstly, Simulation, AR & VR have a high impact as they allow creating real-life like training cases and lower the risk compared to traditional training. High impact also allocated for Artificial Intelligence, data management, Big Data and Data Analytics, they could be useful for spotting imperfections, although surveillance concerns, and the rights of data would need to be assessed, but the issue of purpose and human involvement would remain significant. While, E-Learning and Online Courses, have moderate impact would only need to add this kind of experience missed out in the online course, even virtual. Other technologies including gamification and 3D painting are categorizing to have a low impact. This is solely an assumption of how these progresses could shape as it is done here based on the current trends impact.

Fig.2 Expected impact of New Technologies on Military Academic Education



A- Battlefield Scenarios

AR uses to simulate battlefield scenarios in military training by creating realistic and immersive 3D simulations that allow soldiers to practice their skills and tactics in a safe and controlled environment. For instance, some ways AR used to simulate battlefield scenarios in military training is called Augmented Reality Sandtable (ARES). It has been developed by the US Army, where AR and holographic technology tare used to create a 3D battlefield simulation. Soldiers can use this simulation to practice and plan military operations, such as identifying targets, calling in airstrikes, and coordinating troop movements (Kearney, 2019).

Small Unit Tactics Trainer (SUTT) has been developed by the US Marine Corps, which is an AR-based simulation system that allows soldiers to practice small unit tactics in a realistic and immersive environment. SUTT uses AR technology to provide soldiers with a 360-degree view of the battlefield, allowing them to make better decisions and react to unexpected situations (Chen, 2020a), (Huang, 2020). In addition, Close Combat Tactical Trainer (CCTT) is also an AR-based training system developed by the US Army. It simulates armored warfare scenarios and allows soldiers to practice their skills and tactics in a realistic and immersive environment. CCTT uses AR technology to create realistic simulations of tanks, infantry, and other battlefield elements (Li, 2018).

Virtual Battlespace 3 (VBS3) is an AR-based simulation platform developed by Bohemia Interactive Simulations. It allows soldiers to practice a wide range of military scenarios, from urban warfare to convoy operations. VBS3 uses AR technology to create realistic simulations of the battlefield, including terrain, weather, and other environmental factors (Gao, 2021). Therefore, AR is used to simulate battlefield scenarios in military training by creating realistic and immersive 3D simulations that allow soldiers to practice their skills and tactics in a safe and controlled environment. These simulations can help soldiers develop critical thinking skills, improve their situational awareness, and make better decisions on the battlefield.

AI-based Adaptive Learning Systems, where AI can be used to develop adaptive learning systems that can personalize the learning experience for individual cadet. These systems can analyze a cadet's learning style, pace, and performance to deliver customized content and assessments. This approach has been shown to improve learning outcomes and reduce training time (Roh, 2020). Furthermore, AI-based Intelligent Tutoring Systems, where AI can be used to develop intelligent tutoring systems that can provide real-time feedback and guidance to military cadets. These systems can analyze a student's performance and provide personalized recommendations for improvement, making it an effective tool for self-paced learning and remediation (Wang, 2021).

B- AR-Based Training Compare to Traditional Training

AR-based training has several advantages over traditional training methods, which can make it a more effective and efficient way to train military personnel. For instance, realistic simulation: AR-based training allows trainees to experience a realistic simulation of a battlefield environment, which can help them develop the skills they need to perform well in real-world situations. By simulating different scenarios, trainees can learn how to react to unexpected situations and develop critical thinking skills (Kearney, 2019). Moreover, safe and controlled environment by a scenario with AR-based training allows trainees to learn and practice new skills in a safe and controlled environment. This can help reduce

the risk of injury or damage to equipment, while also providing a space for trainees to make mistakes and learn from them without consequences.

Cost-effective with AR-based training can be extremely lower than traditional training methods. By using AR technology, training simulations can be conducted without the need for expensive equipment or facilities, reducing the overall cost of training programs (Gao, 2021). Finally, flexibility with AR-based training is also more flexible than traditional training methods. It can be conducted in a variety of settings, such as classrooms, training facilities, or even in the field. This can help ensure that trainees have access to training resources when and where they need them (Bianchi, 2021).

Therefore, AR-based training offers several advantages over traditional training methods. It provides a realistic and safe learning environment, personalized learning experiences, and can be more cost-effective and flexible. These benefits make AR-based training a valuable tool for military education and training programs.

VI. Conclusion

This paper has reviewed and demonstrated that new technologies have the potential to revolutionize the way I approach education and can provide a range of innovative tools and resources to help cadets learn and grow. In addition, military education programs must also be cognizant of the need to foster collaboration and communication across different branches of the military, as well as with international partners and other stakeholders. This includes developing leaders who are skilled in interagency and intergovernmental collaboration, as well as those who are able to work effectively with civilian partners and stakeholders.

Finally, academic military education must adapt and evolve to meet the changing needs of the international environment. In future work, by prioritizing the development of adaptable, innovative, and culturally aware leaders who are proficient in the use of new technologies and skilled in collaboration and communication, military education programs can help prepare military leaders to operate effectively in complex and dynamic environments.

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